

**BRITISH SOCIETY
FOR THE
STUDY OF ORTHODONTICS**

1953

P 166

P 77

P. 26. BSSO Committee - 1944.

SA/BSO/5/10

Transactions of the

BRITISH SOCIETY FOR THE
STUDY OF ORTHODONTICS

1953

HEADQUARTERS
Manson House, 26, Portland Place, London, W.1

Published for the Society by
Saward & Company, 1-5, Honduras St., London, E.C.1

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Holland, N. W. A., 17, Chapel Ash, Wolverhampton.
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Suffolk.

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 Carton-Kelly, L. D., Cloncarrig, North Common, Weybridge.
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 Frischmann, I., 215, Tolworth Rise, Surbiton.
 Heath, C. A. J., Canberra, 77, West Hill Avenue, Epsom.
 Kelham, Miss M. M., 2, Woodmansterne Road, Carshalton.
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 Chisholm, I. M. G., Droxford House, Charles Road, St. Leonards on Sea.
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 Hollick, R. L. B., 15, Calthorpe Road, Edgbaston, Birmingham 15.
 Matthews, T., 42, Sheep Street, Stratford-on-Avon.
 Shilton, Miss H., 353, Birmingham Road, Sutton Coldfield.
 Tibbatts, Mrs. M. A., 21, Marlborough Road, Castle Bromwich.

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Godfrey, O. Harcourt, Croft House, Bourne Hill, Salisbury.

Worcestershire.

Godfrey, W. G., Buckingham House, Graham Road, Gt. Malvern.
 Strickland, J. H., Buckingham House, Graham Road, Gt. Malvern.

Yorkshire.

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 Heylings, R. T., c/o Hanover House, Batley.
 Sclare, Miss R., 5, Sandhill Drive, Alwoodley, Leeds.
 Shaw, H., 53, Gledhow, Wood Grove, Leeds, 8.
 Townend, B. R., 131, Manygates Lane, Sandal, Wakefield.
 Wood, T. Jason, 6, Mornington Villas, Manningham, Bradford.

SCOTLAND

Aitchison, J., Glasgow Dental Hospital, Renfrew Street, Glasgow, C.3.
 Anderson, H. A., 4, Clifton Place, Sauchiehall Street, Glasgow, C.3.
 Archibald, W. C., 125, Nethergate, Dundee.
 Baker, A., 11, Church Crescent, Dumfries.
 Buchan, A., 194, Ferry Road, Edinburgh, 6.
 Campbell, J., 74, Highburgh Street, Glasgow.
 Comrie, P. J., Hope Park, 15, Victoria Road, Broughty Ferry West, Dundee.
 Hopkin, G. B., 67, Cluny Gardens, Edinburgh, 10.
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 Kemball, C. H., 20, Ainslie Place, Edinburgh, 3.
 Logan, W. Russell, 8, Chester Street, Edinburgh.
 Logie, D., 86½ Crown Street, Aberdeen.

McEwan, J. D., Edinburgh Dental Hospital, 31, Chambers Street, Edinburgh.
 McGibbon, D. M., 13, Hatton Place, Edinburgh.
 Mears, Miss R. I., 171, Balsusny Road, Kirkcaldy, Fifeshire.
 Miller, Miss M. N., 13, Inverleith Place, Edinburgh.
 Munro, D., Dundee Dental Hospital, 2, Park Place, Dundee.
 Murray, J., 14, Albyn Place, Aberdeen.
 Nicol, W. A., 62, Forsyth Street, Greenock.
 Ritchie, G. S., 146, Nethergate, Dundee.
 Webster, Miss E. M., 19, Royal Crescent, Glasgow 3.
 White, T. C., 6, Cavendish Drive, Newton Mearns, Glasgow.

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Some Abnormalities of the Deciduous Dentition

B. C. LEIGHTON, HDD (*Glas*), DDO,
King's College Hospital Dental School

IN the past little attention has been given to irregularities of the deciduous dentition. In fact, as recently as 1920 it was stated that they do not occur at all. Recently research, in seeking the causes of irregularities, has delved further and further back in the life history of the individual. As our treatment, whether therapeutic or preventive cannot be instituted until after birth, any study of the dentition during the first five years of life would be of great practical value to us.

Following a systematic investigation of 3,000 children between 2 and 5 years of age, I am attempting to show some of the abnormalities that occur, and their frequencies, to stimulate your interest rather than to give you information.

I shall first show models of two cases

which although they appeared normal at first, later showed a strong tendency to distoclusion. In *fig. 1* are shown models of a child at 6 yrs. 1 m. and 8 yrs. 5 m. This child sucked his thumb until 7 years of age. The effect of these habits therefore may not be manifested until quite late in life, but usually the effects are evident at an early age. *Fig. 2* shows another case which appeared normal before shedding of the deciduous incisors but later developed a distoclusion. These models were made at 7 yrs. 10 m. and 9 yrs. 8 m. respectively. Edge to edge bite as shown on the left, occurs in about 3% of all children between 2 and 5 years of age, although attrition of the incisors occurs more frequently.

My third case has a bilateral cross bite in the second deciduous molar region and

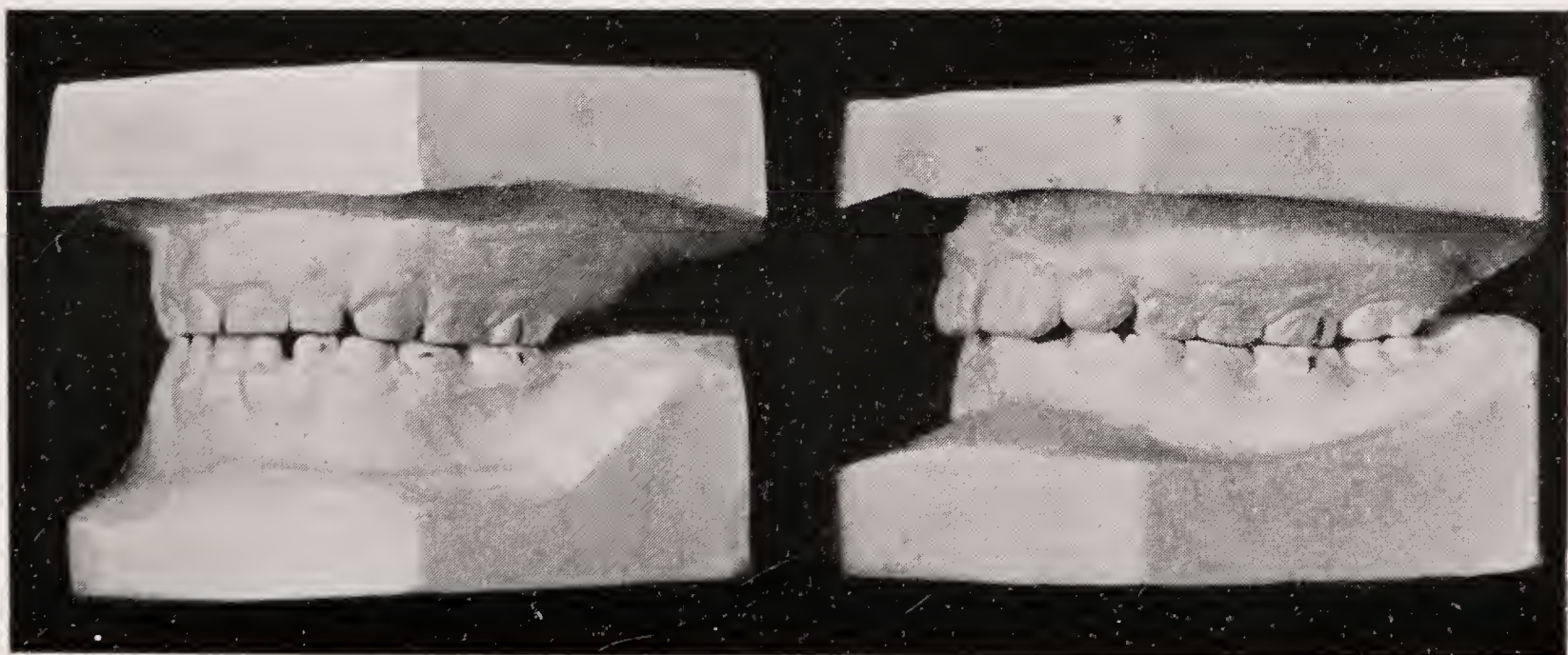


FIGURE 1

Models of boy at ages 6 yrs. 1 m. and 8 yrs. 5 m. Note developing distoclusion. Thumbsucking until 7 yrs.

Paper presented to the meeting on 12th January

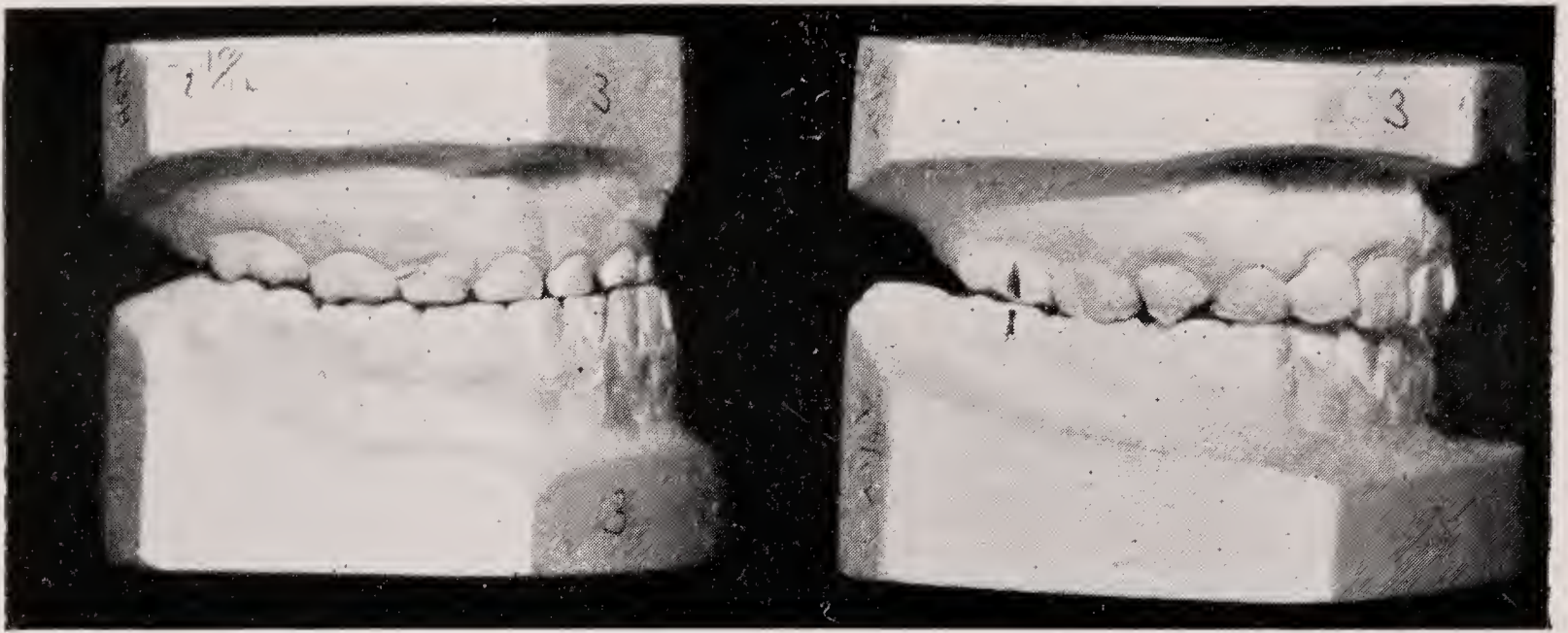


FIGURE 2

Models of girl at ages 7 yrs. 10 m. and 9 yrs. 8 m. Distoclusion is developing.

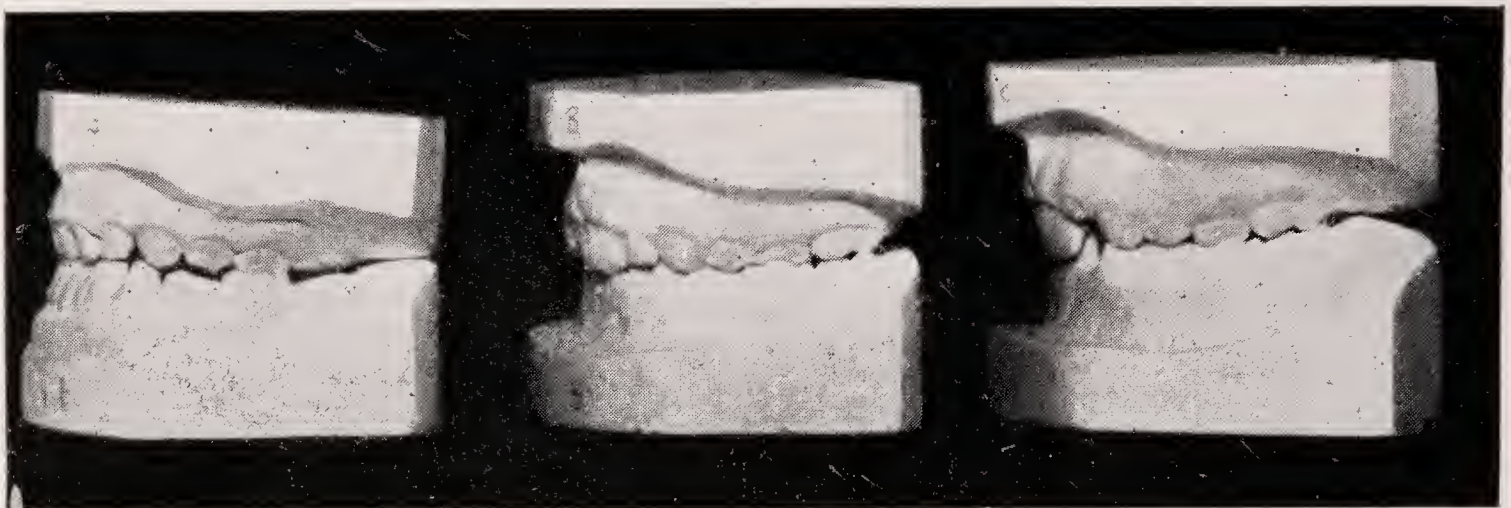


FIGURE 3

Models of girl at ages 5 yrs., 7 yrs. 7 m. and 8 yrs. 3 m. Note linguoclination of incisors, more obvious in last pair.

an apparent linguoclination of the upper and lower incisors. This inclination was emphasised when the permanent first incisors erupted. Once more a tendency to distoclusion is developing. It was not until after hearing Mr. Rix's paper in October that I spotted the cause of the incisor irregularity. *Fig. 4* shows the child in the act of swallowing.

Now I should like to show you two cases that appeared abnormal from a very early age. *Fig. 5* shows two models of a youngster at 8 m. and 1 yr. and *fig. 6* at 1 yr. 6 m. and 2 yr. 1 m. It will be noticed that although he sucked his thumb and still does so, the degree of distoclusion appears to have been reduced. In the second case *fig. 7*, another case of thumbsucking, the

degree of distoclusion has not decreased—these models were taken at 1 yr. 1 m., 2 yrs. and 3 yrs. 1 m. One is tempted to believe that these habits only maintain a relationship of the dental arches that was present very early in life, if not at birth.

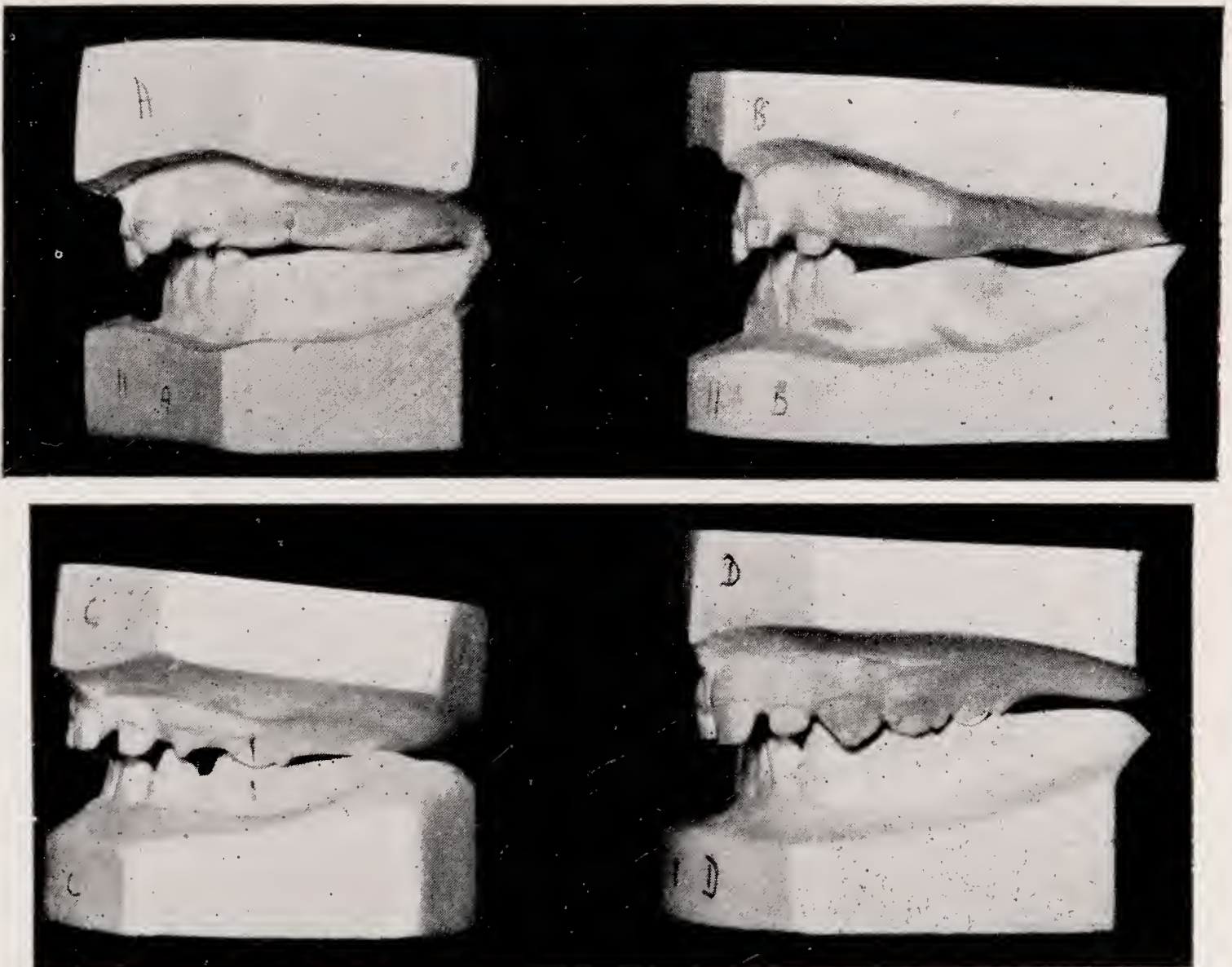
The next case is one in which there was a normal anteroposterior relationship of the dental arches. *Fig. 8* shows models of this child who abandoned a sucking habit at 4 years. On the left are models at 2 yrs. 10 m. and on the right at 5 yrs. 3 m. It will be seen that the incisor relationship has improved considerably.

If the habit be abandoned earlier than 2 years, no apparent deformity results. The next case, *figs. 9 and 10*, gave up the habit at 1 yr. of age. This case is interesting



FIGURE 4

Child whose models are shown in Fig. 3, in the act of swallowing.



FIGURES 5 and 6

Models of boy at ages 8 m., 1 yr., 1 yr. 6 m. and 2 yrs. 1 m. Thumbsucking is still indulged.



FIGURE 7

*Models of girl at ages 1 yr. 1 m.
2 yrs. and 3 yrs. 1 m. Thumb-
sucking is still indulged.*

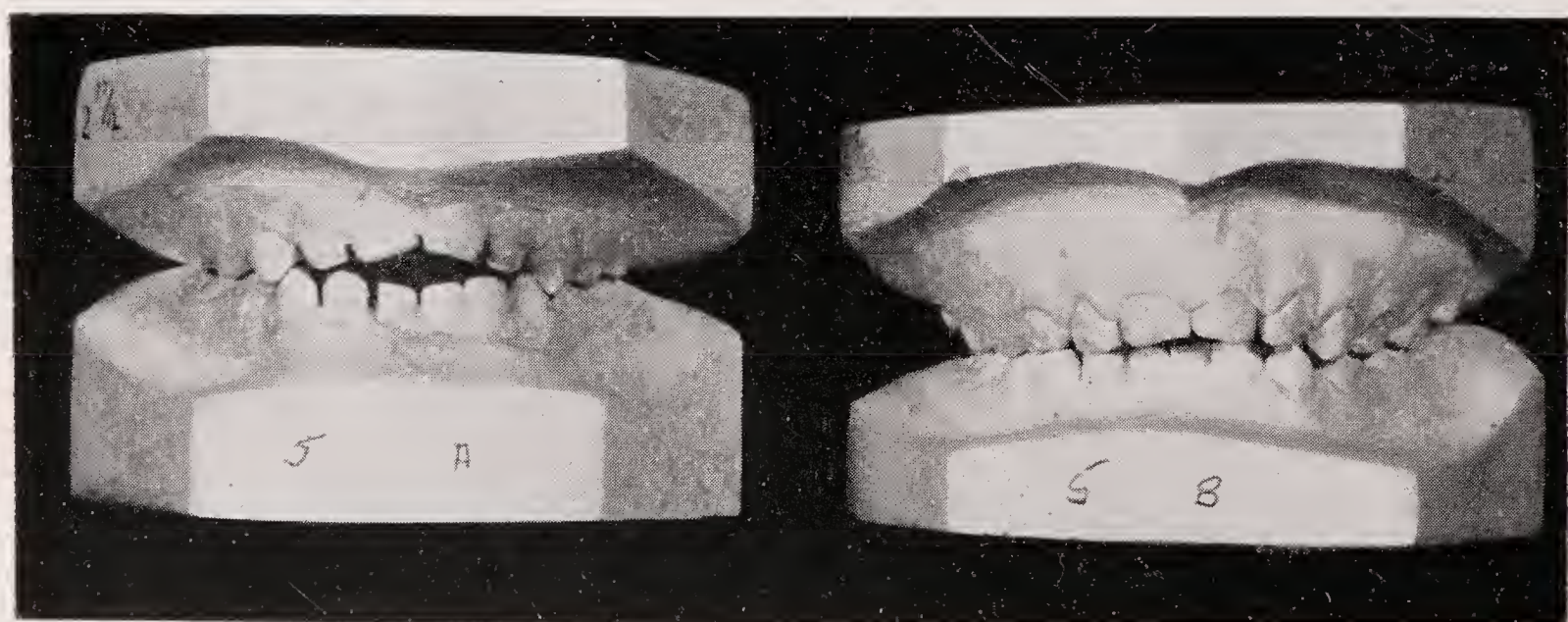


FIGURE 8

Models of girl at ages 2 yrs. 10 m. and 5 yrs. 3 m. Thumbsucking ceased at 4 yrs.



FIGURE 9

Models of girl at 4 yrs. 5 m. There are two supplemental lower incisors, and a distoclusion.



FIGURE 11

Models of boy at 4 yrs. 2 m. The upper right first incisor lost nine months previously.

missing teeth are found in almost the same frequency, 0.9%.

Crossbite in the molar region is frequently associated with sucking habits in Class 1 cases. It occurs in 1.1% of children. *Fig. 11* shows a case where the upper right first incisor was knocked out 9 months before the models were made. Half of the incisor space is lost already. There is a distoclusion on the right side.

Small crowded arches are seen in 1% of children. *Fig. 12* and *Fig. 13* show models of such a case at 4 yrs. 3 m. and 6 yrs. 1 m. It is noteworthy that a distoclusion has been caused by the rotation of the permanent upper incisor.

It is obvious from an early age that this child will never be able to accommodate thirty-two teeth. She had infection of the tonsils which had to be removed.

About 0.4% of these children have an upper arch so excessively wide that the upper molars bite completely outside the lower, on one or both sides—but usually only the right side. One of these is shown in *fig. 14*. It is doubtful if this condition can be resolved naturally at the change of dentition.

I should like now to draw your attention to an apparent anomaly that occurs sometimes, often in cases that are otherwise quite normal—namely an excessive width of the upper arch in the first molar region,



FIGURE 10

Occlusal view of models shown in Fig. 9.

in that there are two supplemental lower incisors which were present at birth. There is a distoclusion of 1 unit which is at present a perfectly satisfactory relationship. It is not known whether there are supplemental permanent incisors. I should mention here that in the deciduous dentition supernumerary teeth occur in 0.8% of cases, and it is significant that

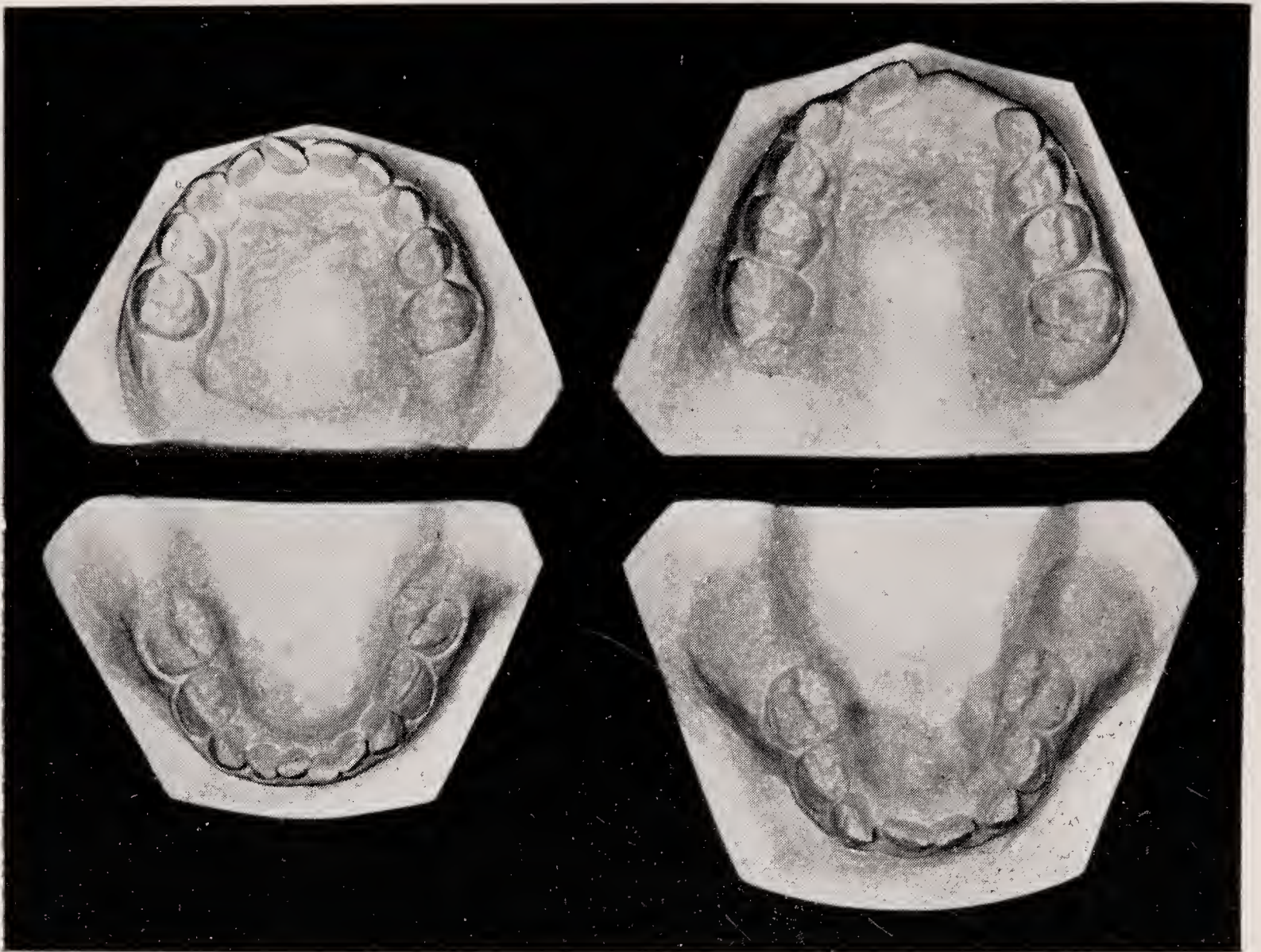


FIGURE 12

Occlusal view of models of girl at ages 4 yrs. 3 m. and 6 yrs. 1 m. Note rotation of incisors.



FIGURE 13

Models of same case as Fig. 12—note distoclusion developing.



FIGURE 14

Models of boy aged 4 yrs. 6 m. Note buccal relationship of upper molars on right side.

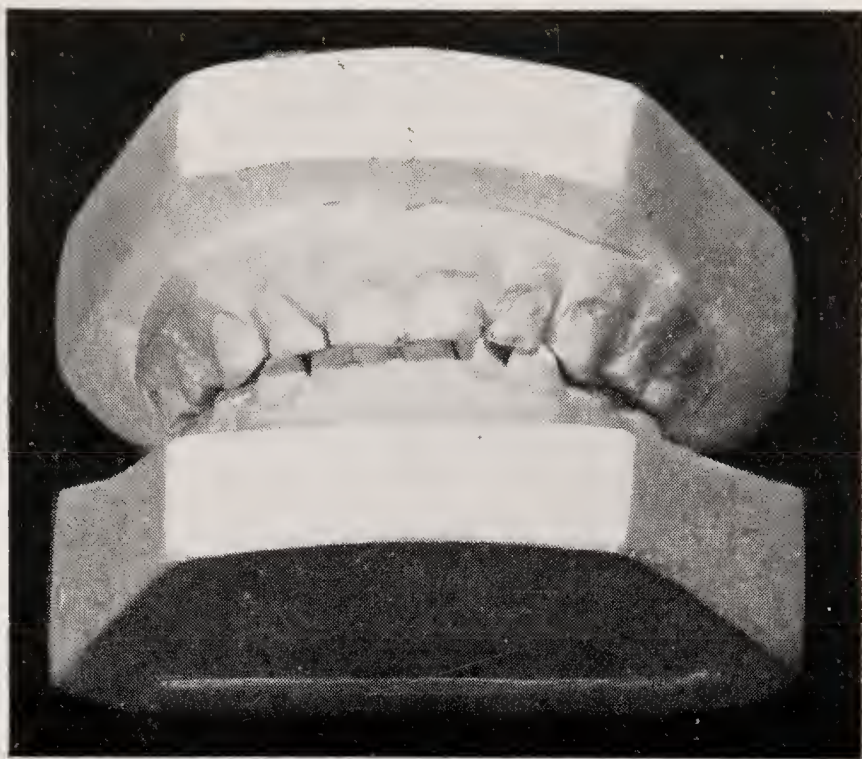


FIGURE 15

Models of boy aged 3 yrs. 11 m. The upper arch appears excessively wide in D/D region.

fig. 15. Although there is no evidence on the subject at present, may I suggest the possibility that this may be due to an increase of width in preparation for a forward movement of the mandibular arch? This child, I should mention, had done his best to produce an abnormality—he sucked his thumb until 1 year of age, he breathes through his mouth as well as nose, and had to have a tonsillectomy, and finally had selected a mother who lost her teeth early, a father with a Class II dental relationship, and a sister with a similar relationship of the teeth!

These models have been collected quite casually, many of them among the younger brothers and sisters of patients attending King's College Hospital. Others were collected in the Maternity and Child Welfare centres of Birmingham City

Council. The incidence of the abnormalities was calculated from statistics of 2,700 children examined in Birmingham.

I hope I have indicated in some measure how great is the opportunity for observation and research afforded to the public dental officer, who alone can see a fair cross section of the population in large numbers.

My thanks are due to Professor Humphreys who supervised the earlier part of this work, to Dr. Jean Mackintosh and the Health department of Birmingham City Council where the statistics and some of the cases were collected. I am also indebted to the staff of King's College Hospital Orthodontic Department whose enthusiasm has provided access to many patients not normally seen in such a department.

DISCUSSION

The PRESIDENT said he had been interested to see that in one case shown by Mr. Leighton there was a Class II Division 2 post-normal occlusion, which he himself had never seen in the temporary dentition. He had looked up the incidence of it and had found that a number of orthodontists of considerable experience in taking statistics of the incidence of malocclusion, regarded it as a rare condition in the temporary dentition. He would be glad if Mr. Leighton could give a little more information about it. It was a matter of interest that before Dr. Northcroft's Presidential Address in 1929 all the textbooks referred to malocclusion in the deciduous dentition as being very rare indeed.

Miss L. M. CLINCH, in opening the discussion on Mr. Leighton's paper, said that she was particularly interested in the early diagnosis of malocclusion. There was no type of malocclusion which could not be found in the deciduous dentition, and it was important to diagnose the condition, because in some cases the cause could be removed by a short period of treatment and normal growth could then complete the cure, and in any case the malformation could be prevented from developing further.

Mr. Leighton had shown Fig. II as a case tending towards distocclusion, but she would be very surprised if the first permanent molars were not in normal occlusion after the loss of all the deciduous molars. She thought that the case was one of a temporary malrelation due to the loss of the maxillary molars earlier than the mandibular molars, whose antero-posterior width was considerably greater than that of the maxillary first premolar and the second deciduous molar.

Fig. III seemed to her to be a typical Angle Class II Division 2 case, complicated by the lingual occlusion of the deciduous molar. Even in the first models

there was a postnormal occlusion, as the distal surface of the upper and lower E were edge to edge, which, though normal at 3 years, was abnormal at 5 years. Like the President, she would be glad to hear from Mr. Leighton what was the incidence of Class II Division 2 cases in the deciduous dentition. She would have thought that it was exactly the same as the incidence in the permanent dentition.

In thumb-sucking cases she thought it was common to find the damage done only in the incisor region, if there was no inherited tendency to postnormal occlusion, and in this type of case there was usually a decided improvement, without treatment, when the habit was stopped at an early age. In the case shown in Fig. VII it was probable that there would have been postnormal occlusion even without the sucking habit.

Mr. Leighton had stated that small arches were present in 1 per cent of children, and she would like to ask him on what age he had based that figure. She had found that some of these cases improved in the later stages.

She agreed with Mr. Leighton that when the first permanent molars erupted in a wider arc than the deciduous arch it was a favourable sign, but she had seen it occur in the mandibular as well as the maxillary arch, and the second permanent molars sometimes erupted in this way.

There was certainly a wide field for investigation into the changes in the deciduous and mixed dentitions. If orthodontists could tell which of the cases would improve without interference and which could be improved by treatment before the permanent teeth erupted, they could lessen the period of treatment very considerably.

Miss K. C. SMYTH said that she agreed that the thumb-sucking habit was far more likely to produce postnormal occlu-

sion when there was an inherited tendency, but she thought that the question of the type of thumb-sucking was important. Where the thumb was pushed up behind the incisors and the knuckle was used to push the lower incisors back, the post-normal position of the mandibular teeth was very much aggravated, but, where the overjet of the upper teeth was not already present to a marked degree and the child bit his thumb rather than sucking it, there was a displacement of upper and lower incisors in a vertical direction rather than antero-posteriorly.

Mr. C. F. BALLARD said he thought that Mr. Leighton's observations were very important.

He had been interested in abnormalities in the deciduous dentition for some years, and he had recently carried out an investigation which had led him to the conclusion that, when thumb sucking was associated with an abnormality, it was either because there was an underlying tongue thrusting behaviour or an abnormality of dental base relationship or both. In other words, if there was a normal dental base relationship and there was no abnormality of the behaviour pattern of the tongue and lips, there would not be an abnormality associated with finger and thumb sucking which would not correct itself when that habit was discontinued.

Mr. Leighton had demonstrated that there were sucking behaviour patterns present in very young infants. That took one back to the old question of whether in fact, if there was a Class II Division 1 abnormality associated with an abnormal swallowing action and a sucking behaviour pattern, that behaviour pattern was inherited. He thought the behaviour patterns of the tongue and lips was inherited. He had among his patients one very large family who had an abnormal behaviour pattern of the tongue and lips which he could trace back to the grandmother.

Mr. W. J. TULLEY asked whether Mr.

Leighton had had any experience of treating prenatal cases in the deciduous dentition with extra oral anchorage. He had not shown any examples in his paper.

With reference to Mr. Ballard's remarks, many abnormal behaviour patterns did not manifest themselves when the dentition was in the deciduous phase. Parents often said that their children had "a lovely set of baby teeth" and they did not notice slight abnormalities in the deciduous dentition, but when the permanent incisors erupted, with their larger crowns, the parents were quick to notice abnormalities.

Mr. J. H. HOVELL, referring to the question of the influence of muscle pattern on the deciduous and permanent dentitions, said that in the deciduous dentition one often saw a far greater effect made by the skeletal pattern than was made by it in the permanent dentition. In the permanent dentition, owing to the larger crowns and roots of the teeth, muscle pattern had a greater effect. Had Mr. Leighton followed that up in the cases which he had shown? He thought it would be of very great interest if Mr. Leighton had done so.

Mr. HOWELL RICHARDS said that he had been particularly interested in the case shown by Mr. Leighton in which there was a distoclusion of the temporary molar teeth and supplemental lower incisors. In case of distoclusion one frequently found the normal number of incisors imbricated and very close together. In the case shown by Mr. Leighton there was a distoclusion, with two extra lower incisors yet a normal incisor relationship and no imbrication. That, he thought, suggested that the patient had perfectly normal muscular environment to the arches, and it would be interesting to follow up the case in order to see what happened in the permanent dentition.

He had a patient, now aged 18, who had distoclusion of the permanent molar teeth and of the 5's; there was a point to point

occlusion in the 4 region and the incisors were in normal relationship. That meant, of course, that in the lower arch there were spaces between the 2's and 3's and between the 3's and 4's. Therefore with a distoclusion of the molars and a normal relationship of the incisors, the extra antero-posterior depth was made up by spacing in his case and by additional teeth in Mr. Leighton's case. He thought that was because in his case the tongue fulfilled its proper function in maintaining spaces in the lower arch at the age of 18. He would like to see what happened in Mr. Leighton's case, where there were two extra teeth in the temporary dentition but there might not be two extra teeth in the permanent dentition.

Mr. K. E. PRINGLE said with regard to the Class II Division 2 type of case, it seemed to him that in the deciduous dentition one saw the deep incisor overlap rather than the over-lapping laterals. That was followed by Class II Division 2 occlusion in the permanent dentition, but the characteristic feature in the deciduous dentition was the close bite anteriorly.

Mr. H. E. WILSON said that in the first two slides Mr. Leighton had shown a case in which he said that there was a tendency to Class II. There was no difference in the relationship between the upper and lower canines in the two sets of models, whereas there was a difference in the molar relationship, and he thought the case could be explained by the movement forward of the upper molars filling up the spaces which were sometimes there and producing the cusp-to-cusp relationship, which looked like a Class II but which might in fact be normal in this case. The condition shown in the second slide could be attributed to the fact that the upper premolar had erupted, whereas the deciduous molars in the lower were still intact. He would describe that not as a Class II case but as being within the normal.

Mr. Leighton had mentioned that in another case he had shown he considered that the molar relationship was due to the rotation of the permanent incisor. He was afraid that he could not follow that at all. Could Mr. Leighton explain how the molar relationship could be the result of the rotation of the permanent incisor?

Mr. H. G. WATKIN thanked Mr. Leighton for his interesting paper and said that he thought the study of the early dentition was very important.

He would like to ask Mr. Leighton what was the incidence of pseudo Class III cases in the deciduous dentition. He had recently had three very interesting ones, the lower incisors occluding in front of the upper incisors. He called those pseudo Class III cases, because the mandible moved forward into a bite of accommodation. All the three children were 3 years of age and in each case an inclined plane put on the upper incisors cured the anterior relationship in a few days, and the molar relationship became normal automatically. Since then the dentitions had been quite normal.

Mr. NORMAN GRAY said he would like to thank Mr. Leighton for his very informative and interesting paper. The case which had particularly interested him was that in which the right upper molars were in buccal occlusion. Mr. Leighton had said that this condition generally occurred on the right side, and he himself had noticed that this was often so. He would like to know whether Mr. Leighton could give the reason for this. Sometimes the cases had a dual bite, and then they could swing over and occlude with a cross bite on the other side.

Mr. B. C. LEIGHTON, in replying to the discussion, said that the President had asked about the incidence of Class II Division 2 cases in the deciduous dentition. First, he would like to say that Class II Division 2 in the deciduous dentition was difficult to diagnose; the cases were not typical, as they were in the per-

manent dentition. Mr. Pringle had pointed out that overlapping lateral incisors did not occur in the deciduous dentition, and there was a large number of Class II cases in which the deciduous incisors were more or less vertical. their inclination was normal and they were neither Division 1 nor Division 2. Therefore he did not think that he would like to trust any figures of the incidence of Class II Division 2 cases in the deciduous dentition, even if such such figures were available, but he agreed with the President that Class II Division 2 cases appeared to be more rare in the deciduous dentition than they were in the permanent dentition. The kind that was seen in the third case that he had shown was very rare, and that case really was a Class II Division 2 case from the beginning. There were many intermediate cases which might be one or the other.

He agreed with Miss Clinch that every type of malocclusion occurred in the deciduous dentition, except, of course, those that were due solely to early extraction of deciduous teeth.

The distoclusion in the series of three models that he had shown had been present in models which he had not shown and which had been taken at the age of 7 or 8 weeks. The degree of overjet then had been very much the same as it had been at the age of 3 years.

When he had referred to 1 per cent of small arches he had meant small crowded arches. It was very difficult to tell whether arches were small or not unless one had some definite standard by which to judge, and he had used the standard of crowding of the incisors. The case which he had shown indicated the degree of crowding that he had used as an example.

With regard to the different types of sucking habit, to which Miss Smyth had referred, he had found that when a case was postnormal, with a large overjet, the thumb or dummy, or whatever was put into the mouth, was put in vertically, whereas in the case of a Class I relation-

ship the thumb was nearly always, not invariably, put in horizontally. The question then arose whether the way of putting the thumb in was due to the degree of overjet which was present, or whether the degree of overjet was due to the way in which the thumb was put in. He thought that the only way to find the answer to that question was to examine children very early in life. The answer could not be found by the examination of children of 2 to 5 years of age; the children must be under 6 months old. He would not like to give a definite answer to the question, but his impression was that the overjet was present very early in life and that the thumb was put into the mouth in the way which was most convenient.

In Birmingham an attempt had been made to assess the number of children with abnormalities in the deciduous dentition who had an infantile type of swallow, but it had been found very difficult to do that, because of the children's chubby little faces. It was difficult to see any change in the muscles of the face, because of the fat, and it was also found that the children would give an infantile swallow one minute and a normal swallow the next. Therefore it was very difficult indeed to obtain any reliable figures on the subject.

With regard to the heredity of habits, he had found that those children who sucked thumbs or dummies tended to be the children of parents who had distoclusion, so probably the parents also had had sucking habits. It was very difficult to obtain information from the parents about themselves in this respect, because very often they did not know whether they had sucked their thumbs or not; if they had, the habit had been abandoned at too early an age for them to remember it.

With regard to prenatal cases, he had with him a slide of a prenatal case which he could show if the members wished to see it, but there was nothing special about it except that it was prenatal. He had found that prenatal cases were difficult

to treat at the age in question. He had a case now which he had been trying to treat for eighteen months or two years, and the patient was no better now than he was when the treatment was started.

He thought that in the deciduous dentition abnormality was very often masked to the layman, first by the normal spacing of the teeth and, secondly, by the chubbiness of the children's faces. They had a good deal of loose soft tissue round the face, and they could have a considerable amount of abnormality without it being apparent externally.

So far he had not been able to follow the children up for a sufficient length of time for him to study the effect of these abnormal habits on the permanent teeth. The only case that might give a clue to that was the second case that he had shown, the little girl who swallowed abnormally.

With regard to Mr. Pringle's remarks about the missing teeth, in his cases the missing deciduous teeth had in most cases been incisors, and the majority had been upper lateral incisors.

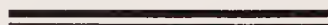
Mr. Wilson had referred to the rotation of the permanent incisor in the case of the little girl with crowded arches. That incisor had undoubtedly been rotated because of the crowding, but there had not been distoclusion when all the deciduous teeth were present. It was only when that incisor erupted that the distoclusion had developed, and the distoclusion was improving; the occlusion was becoming normal as the incisor rotated towards the normal position.

In the case of the children under one year of age, he had taken the impressions and then subsequently put the models together in the presence of the children. He did not think it was necessary for most purposes to take a bite unless one was going to measure the models; for ordinary purposes one could put the models together reasonably accurately in the presence of the child.

He could not give Mr. Watkin figures for the incidence of pseudo Class III in the deciduous dentition, but he could say that Class III as a whole occurred in about 2 to 3 per cent of cases. How many of those were pseudo Class III he could not say definitely.

With regard to Mr. Gray's remarks, he could not explain why the buccal occlusion of the molars occurred more often on the right side than on the left, but it might have something to do with right-handedness, the children biting on the right side more than on the left. He agreed with Mr. Gray that many of them could swing from one side to the other quite happily. He had found the same thing in children with narrow upper arches and wide lower arches, where there was a cross bite on one side or the other; it was difficult to get them to decide on which side they were going to bite.

The PRESIDENT, in proposing a vote of thanks to Mr. Leighton for his paper, said that the considerable discussion which it had evoked showed the interest which the members had taken in it.



Orthodontic Schemes

J. F. PILBEAM, FDS. (ENG.)

WHEN I was admitted to this Society orthodontic treatment was something of a luxury to the vast majority of children, except, of course, for those who lived within easy reach of the dental schools, because few parents could afford private practitioners' fees and there were no orthodontic clinics set up by local authorities. Salzmann stated recently that the question of orthodontics is now no longer something that concerns only those who have a lot of money. Orthodontics is too important in life and in the welfare of children for such a limited view to prevail. The benefits of orthodontics are now appreciated by families of children of every economic level. If this is true, he continues, it is difficult to visualise how the dental health of the children can be assured if orthodontic problems continue to be ignored. In this country the development of the dental services within the framework of the National Health Service has solved the parent's economic problem regarding orthodontic treatment; the difficulty of providing adequate facilities for diagnosis and treatment has, however, to be solved.

INCIDENCE OF MALOCCLUSION

The most common defects among children are decayed teeth, malformed jaws and misplaced teeth. Now what is the size of the orthodontic problem? If we consider statistics recorded by a number of American investigators the incidence of malocclusion is exceptionally high, so

much so that paradoxically the abnormal seems to be the normal for children in America. Massler and Frankel state that almost 80% of children examined had malocclusion. McCall examined a number of children from 2-11 years and recorded an incidence rate of 55% with dental abnormalities. It is of interest to point out that in this survey in the age groups 2-6 years, 38% had malocclusion. It was at one time thought that malocclusion did not occur in the deciduous dentition and the above percentage emphasizes the fallacy of this original contention. I believe the late George Northcroft was the first orthodontist to prove the existence of abnormalities in the first dentition and this was the subject of a most interesting paper read before this Society many years ago. McCall estimated that between 50-75 per cent. of children he examined needed orthodontic treatment. In this country Humphreys and Leighton carried out a comprehensive survey in 1950 and they found that the incidence of antero-posterior abnormalities in pre-school children was, in the case of boys, 27.04% with post-normal occlusion and 1.63% were pre-normal. The percentages given for girls were slightly less. These figures represent a considerable reduction in those put forward by the Americans but to organise a national orthodontic scheme based on these incidence rates would be impracticable. A more reasonable formula must be found. Miss Clinch has said that while the service

is so restricted through the lack of trained orthodontists a careful selection of patients to be treated should be made to correct only those malformations which are likely to be most injurious to health. Working to this formula, I have conducted three separate surveys examining more than 500 children on each occasion and my findings were that the incidence rate was within the range of 5–7 per cent. I believe that Harold Chapman and Russell Logan have recorded similar percentages. When it is realised that there are over six million children of school age in this country, the incidence of 5% with orthodontic defects represents a tremendous number to be dealt with, which is far beyond our slender resources. It is, therefore important that we should harness our resources to create a better and more efficient orthodontic service to enable us to offer the greatest good to the greatest number.

THE FOUR AGENCIES FOR TREATMENT

The National Health Service is a composite scheme with the typically British characteristic about it—the art of compromise. All services existing before the appointed day were continued afterwards as separate entities, hence children can obtain orthodontic diagnosis and treatment through the general dental service, the school dental service, dental teaching hospitals and at general hospitals.

GENERAL DENTAL SERVICE

Under the general dental service, any dental practitioner whose name is on an Executive Council Dental List can prescribe and undertake orthodontic treatment, there being no previous ‘screening’ of the practitioner as to his ability to treat dental abnormalities. While there are some general practitioners with the necessary skill and experience to undertake efficient orthodontic care there are, unfortunately, many who have not the knowledge of the basic principles of orthodontic diagnosis and treatment sufficient to warrant satis-

factory conclusion of treatment. This point of view was emphasized in the Report of the Special Committee set up by the Council of the Society in 1944, to consider orthodontic treatment of school children and post-graduate education. The Majority Report asseverated that orthodontic diagnosis and treatment should only be undertaken by specialists in orthodontia who have received adequate post-graduate training. This recommendation was made because, as the Report says, it is not possible to include adequate training in orthodontics during the undergraduate course. The Majority Report indicated that a national orthodontic service should be based on the specialist and not on the dentist. The first step, therefore, in the setting up of a comprehensive orthodontic service is the development of post-graduate study in order to train more orthodontists. The Institute of Dental Surgery in London is doing excellent work through its orthodontic department, under the able control of Mr. C. F. Ballard, to provide post-graduate teaching but more of these centres are required. Some of the teaching hospitals also arrange limited opportunities for post-graduate instruction but the sum total of all facilities is insufficient to meet the demand for training.

Until there are sufficient orthodontists, even for a skeleton service, we must be prepared to accept some temporary lowering of our standards in the national interests. In some ways the obstetrical service has a similar problem to our own and consideration might be given to our adopting a scheme on identical lines to that employed in the practice of midwifery through the general medical service under Part 4 of the Act. In this scheme there is a selection of general medical practitioners to practise midwifery. The experience of general practitioners who desired to be selected was reviewed by a local ad hoc committee of a wholly professional character consisting of local general

medical practitioners, a consulting obstetrician and the local health authority's medical officer of health. The local committee drew up a list of approved local practitioners and was entitled to indicate to those not accepted for such a list the need for further obstetrical experience. This list is reviewed from time to time to ensure that doctors on it are continuing to undertake enough midwifery to remain competent to practise and adding the names of future entrants to the profession as they acquire the necessary experience.

The general features of this scheme could, with advantage, be applied to orthodontics by setting up local orthodontic committees with similar power to assess the orthodontic abilities of dental practitioners who wish to practise orthodontics. These committees could be sub-committees of the local dental committees, provided they had adequate orthodontic representation by appointing a consultant orthodontist. In putting forward this proposal, I am aware that under the Regulations of the General Dental Service, 1948, provision exists in the First Schedule for a private practitioner to refer, if he so wishes, a patient to another practitioner whose name is on any dental list, but there is no assurance that in the case of orthodontic treatment the patient would be referred to another practitioner with the necessary experience in orthodontics. An 'orthodontic' panel on the lines suggested would offer some guarantee that the child would be treated by a dental surgeon reasonably well versed in orthodontic diagnosis and treatment. Such a scheme might help to eliminate some of the inordinate delays in obtaining approval for treatment from the Dental Estimates Board by creating greater confidence and trust all round. Finally, the eradication of empirical treatment by the inexperienced should be the means of saving much wasted public expenditure, which might be applied to increasing and stabilising fees

for better orthodontic treatment. Before leaving the matter of special aptitude and ability to treat orthodontic patients it seems appropriate to quote the views of Salzmann, who says: "At present any dentist is allowed to practise orthodontics, but there should be certain criteria for accepting persons to render service for children paid for by public funds. There must be certain basic qualifications which a dentist should possess before the State Health Department authorises him to treat a child, the operator should show proof of his ability to perform satisfactorily this type of work. The State Health Authorities, with expert assistance, should make an appraisal of their qualifications and, if found satisfactory, add the applicant to the list of qualified operators to whom patients may be referred."

LOCAL EDUCATION AUTHORITIES

Local education authorities' interest in orthodontics, which at first was limited to a few progressive authorities, is now much more universal, in fact it is true to say that the majority now have some arrangements in being for the treatment of malocclusion, though many have only inchoate schemes. There are three types of orthodontic schemes organised by local authorities, which may be briefly summarized as follows:—

- (a) School dental officers with a flair for orthodontics undertake diagnosis and treatment, allocating about one session each week to prevent too much encroachment by orthodontics on their general treatment time. The inherent disadvantage to this scheme is similar to that expressed in the case of general dental practitioners.
- (b) Orthodontists are appointed to visit various clinics to which selected children are sent for diagnosis and treatment, the prescribed treatment being undertaken by the school dental officer. The essential problem in this type of scheme is the difficulty of interpretation by the school dental officer of the

orthodontists' prescriptions. The school dental officer, especially in the rural areas, has little opportunity to become conversant with modern orthopractic techniques and the child has, therefore, to be referred back frequently to the orthodontist.

The Department of Health for Scotland has recently published a report by the Sub-Committee of the Standing Dental Advisory Committee entitled: 'Preventive Dental Services'; in Appendix 7 there is a report of a Pilot Experiment of an Orthodontic Scheme conducted in Fife by Mr. W. Russell Logan and Mr. W. Rodger, which lends favour to the appointment of an orthodontist working in collaboration with the school dental officer, who, in general, undertakes the orthopractic treatment. This short experiment of six months seems to have been outstandingly successful and in the Statistical paragraph 9 it is claimed by deduction that a full time consultant might be expected to handle at least 3,700 total cases per year, of which some 2,400 would be diagnoses. This total of 3,700 seems to be rather excessive as compared with the usual standards in this country.

- (c) The third type of orthodontic scheme is one in which orthodontists and assistant orthodontists are appointed to diagnose and treat all children referred to them by the school dental officer. The selection of children for the orthodontists is done by the school dental officers.

After many years of experience of these three types of orthodontic schemes, I feel firmly convinced that the last one in which the orthodontists shoulder the whole burden of diagnosis and treatment is the most convenient and efficient scheme. Moreover, I have found that, in general, dental officers prefer this one to the others, and their interest in orthodontics is not

impaired through their lack of active participation in orthopractic treatment. From the administrative angle, this type of orthodontic scheme has the advantage that it does not interfere with the general routine work of the school dental service, which is an important point. The expansion of orthodontic schemes in the school dental service is enabling an increasing number of children to receive efficient orthodontic treatment and the work which is being done is deserving of the highest commendation.

The development of orthodontic schemes throughout the country has aroused the interest of school dental officers in the field of orthodontics and this is reflected in the increased membership of this Society by school dental officers. Local education authorities are also sharing in this great interest, for many have now constructed ad hoc orthodontic clinics which are fitted with modern equipment.

Since the appointed day the Minister of Education has on several occasions drawn the attention of local education authorities to the fact that, after that, the duty of providing a comprehensive priority dental service for school children will continue to rest with local education authorities. The important word is 'comprehensive', which connotes the inclusion of orthodontics as an integral part of the school dental service. This point of view is further stressed in the Ministry of Education Circular, 254, and in the Education (Miscellaneous Provisions) Bill, 1952, which is now before the House of Commons. Under the Education Act, 1944, local authorities have power to arrange for children attending maintained and non-maintained schools to receive treatment but only children attending the former schools have the privilege of treatment. This means that about 15% of the school population are unable to seek dental care through the school dental service. The school clinics do not, there-

fore, cater for the orthodontic and general needs of children attending private schools, and other arrangements have to be made.

TEACHING HOSPITALS

The majority of children receiving care are, at present, probably dealt with in the dental teaching hospitals and in the Institute of Dental Surgery. The function of the teaching hospitals is to teach and the staff should not be burdened with the heavy task of treating large numbers of children, which prevents their having sufficient time to teach students the elementary principles of orthodontics. The orthodontic treatment of children attending the teaching hospitals should, therefore, be confined to a selection of patients whose deformities illustrate types of malformations of special interest for teaching students.

REGIONAL HOSPITAL BOARDS

Speaking in general terms, it is true to say that little orthodontic practice is carried out in general hospitals controlled by Regional Hospital Boards. In some regions, however, a start has been made to regard orthodontics as a specialty of dentistry. The South West Metropolitan Regional Hospital Board must be given pride of place for appointing the first full-time consultant orthodontist. Mr. Hooper, who was appointed to this post, is doing excellent work in blazing the trail of orthodontics in this Region. The Birmingham and Aberdeen Regional Hospital Boards have also appointed consultant orthodontists, and more recently it is understood that the South-East Metropolitan Regional Hospital Board has added a consultant orthodontist to the dental staff of the Plastic and Jaw Unit at East Grinstead. It is a matter of some surprise to me that the appointment of a consultant orthodontist is not regarded as a *sine qua non* on the dental establishment of these special centres. In the treatment of cleft palates the services of an orthodontist

should prove an invaluable aid to the surgeon and dental surgeon. The North-West Metropolitan Regional Hospital Board have also recently approved the appointment of a part-time consultant orthodontist.

It is appropriate at this stage to say that the Minister of Health indicated in Circular R.H.B. (48) 48, that the Boards were responsible for providing hospital and special services for children, as for other members of the community, and, in addition, it would normally be appropriate for Boards to take over also the responsibility for providing out-patient specialist services for school children, hitherto provided by local education authorities and school clinics, or other premises which were not transferable to the Minister. It is, however, for the Boards to determine how far this work could be regarded as the proper responsibility of the hospitals and the specialist services and, if so, how, when and where the necessary facilities and staff should be provided. Having regard to this Circular, it is, therefore, not unreasonable that dental surgeons engaged in full-time and part-time capacities as orthodontic surgeons in local authority clinics have asked why is their work not regarded as of a specialist nature and their appointments taken over by the appropriate Board and graded accordingly. As the Minister has stated, it is, however for the Board to decide where it regards, in this case, orthodontics as a specialist service. Only in one Region has a Board assumed complete responsibility for all special clinics established by a local health and education authority. It is regarded as being highly improbable that other Boards will adopt a similar policy. The future policy may be the direct appointment of consultant orthodontists by Regional Hospital Boards and the services of these consultants made available to local authorities.

The general view of senior administrative medical officers, who are responsible to the

Boards for giving advice on health matters, is that dental surgery is the specialty of dentistry and it is therefore illogical to have a specialty in orthodontics, which is really creating a specialty within a specialty. Be this as it may, there is, however, an increasing section of the profession who are of the opinion that the field of dentistry is now so comprehensive that it permits of some sub-division. If this view were generally accepted by the profession and outside it, it would be possible to obtain recognition of a specialty in orthodontics. I can think of no better way to encourage the practice of orthodontics as a specialty than to initiate a protracted post-graduate course which would lead to the taking of a diploma in orthodontics. I believe that an increasing number of dental surgeons are taking the Glasgow University Diploma in Dental Orthopaedics, which is indicative of the need for such a qualification, and it is to be hoped that there will soon be an English equivalent to this diploma.

Specialisation in dentistry is not a new theme because fifty years ago it was being debated by the profession of the day. The following extract from the "*Journal of the British Dental Association*," October 15th, 1902, is of more than passing interest, which states:—"Where the specialisation of specialties may lead can hardly be foreseen and we even await the prophesied eminent rhinologist devoted to the left nostril. That dental surgery admits of much division of labour without detriment is unquestionable, but the swing of the pendulum may well be too far. It appears that the orthodontist has already arrived in America and there is a Society, of two years standing, meeting at about this time in Philadelphia." Five years later the British Society for the Study of Orthodontics was formed and since then orthodontics in this country has steadily progressed, but still there is no unanimity as to whether orthodontics can be regarded as a specialty of dentistry, and in fact

whether dentistry admits of some specialisation. The argument has gone on for fifty years and here I propose to leave it, for it will probably continue for another fifty years.

After this short digression, I must return to my earlier remarks regarding the provision of out-patient specialist orthodontic facilities for children at general hospitals as a proper responsibility of Regional Hospital Boards. In order to prevent any misunderstanding it must be categorically stated that the orthodontic service established by the local health and education authorities has served, and is continuing to serve, a very valuable purpose and must remain the responsibility of local authorities and be expanded as rapidly as possible. In addition to establishing such a service they supply a useful follow up service through school nurses, care committee workers and others employed by local health and education authorities to encourage parents to accept treatment for their children. It would, therefore, not be in the best interests of the children concerned if this service were transferred to the administrative control of Hospital Management Committees. The view I am putting forward is accordingly not one of transfer of responsibility, but one of material aid and co-operation through participation in a consultant orthodontic service organised and provided by Regional Hospital Boards and placed at the disposal of local health and education authorities. These hospital consultant facilities would also be available to practitioners participating in the general dental service and might be organised to provide for the following:—

- (1) The treatment of difficult deformities beyond the ability and scope of the general dental practitioner and the school dental officer.
- (2) A scheme of consultation between the orthodontist and practitioners taking part in the general dental service and the school dental service.

- (3) Consultation and treatment of patients referred from other branches of the National Health Service, particularly E.N.T. surgeons, plastic surgeons, paediatricians and speech therapists.
- (4) The promotion of local study circles or refresher courses for dental practitioners to be taken by the orthodontist, to stimulate interest in diagnosis and treatment.
- (5) To undertake research into orthodontic problems and allied subjects.

A hospital consultant orthodontic service based on these postulates would make a valuable contribution to the general dental service and to the school dental service. The ultimate aim would be to establish this specialist service within each hospital region by the appointment of an orthodontist, either part-time or whole-time, as the need enquires, to each group of general hospitals. The present economic situation, the shortage of trained orthodontists and the general lack of dental surgery accommodation prevents such a scheme being implemented to the full. It is to be hoped, however, that these difficulties, great as they are, will soon cease to be obstacles in the way of full development of a hospital consultant orthodontic service. There is a large pool of potential orthodontic therapy in the areas served by the general hospitals valuable for the training of orthodontists, and is therefore essential in the establishment of the service that provision should be made for the appointment of house surgeons and registrars to train as orthodontists. Senior hospital dental officers with experience in orthodontics would also be required.

The appointment of orthodontic consultants by Regional Hospital Boards and their secondment to the school dental service, rather than their direct appointment by local authorities, has been advocated for five main reasons. Firstly, the school dental service deals with children at maintained schools only, although as has been previously stated, local authorities

have power to include the dental care of children at private schools but do not do so because of staff shortage. Secondly, under the school health service there is no scale of remuneration of consultants comparable to section (1) of the Terms and Conditions of Service of Hospital Medical and Dental Staff, and therefore the school health service would not continue to attract orthodontic surgeons of consultant status. Thirdly, there are many young adults for whom orthodontic treatment can be successfully undertaken who are, of course, not eligible for dental care under the school health service. The selection of adult patients amenable to treatment can often be the means of giving a better opportunity for health and happiness. The fourth reason is that there are free monies held by Regional Hospital Boards which have accumulated from endowment funds and which are placed at the disposal of the Hospital Management Committees to use for special purposes such as research. An orthodontist keen on research would, therefore, have a good opportunity to obtain the necessary monetary assistance for a worthwhile investigation. Finally, it is desirable that in his field of work the orthodontist should have readily at hand other specialist facilities for consultation, which are available at large general hospitals.

COLLECTIVE RESPONSIBILITY

Having spent some time discussing the four agencies under which orthodontic treatment is available through the National Health Service, the question might well be asked, "which service is really responsible to provide an efficient scheme?" The school dental service has its own responsibility in the matter, so has the hospital dental service, the general dental service and also the teaching hospital, but if we think in terms of individual service responsibility little headway will be made because each service has its own peculiar problems. We must think in terms of collective

responsibility, with full co-operation among all the services, for this alone will solve the problem of providing better opportunities for diagnosis and treatment. The Ministry of Health has recently issued a Circular R.H.B. (52) 42 dealing with co-operation between hospital, local authority and general practitioner services, which has been sent to Regional Hospital Boards, Local Authorities and Executive Councils. If the principles of co-operation as outlined in this Circular are accepted in the right spirit by those responsible for the services described, then the National Health Service as a whole will greatly benefit.

THE FUNCTION OF THE ORTHODONTIC SERVICE

In a national orthodontic scheme it is essential that we maintain a true perspective of our responsibilities bearing in mind that the incidence of malocclusion is high and treatment resources limited. These two important factors must be ever present in our minds. A high degree of perfection must be our aim but striving for perfection is time consuming and not always in the best interests of the service as a whole. In order to increase the volume of treatment by saving treatment time, it is desirable that all should consider the advisability of using more removable appliances, as new types are being devised which fulfil some of the essentials only previously obtainable by using fixed appliances. Some experienced orthodontists maintain that this could be done without sacrificing standards. But whatever means of economy in time or method we choose to increase our potential treatment time, no orthodontist should have a case load which would prevent his having sufficient time for diagnosis and adequate treatment. The aim of an orthodontic service is to achieve functional occlusions; dentitions able to resist more resolutely the onset of dental caries and periodontal disease, which will greatly assist the patient to undertake more

efficiently home care of the mouth. A good functional result is frequently a satisfactory aesthetic result, but a good aesthetic treatment does not necessarily mean a satisfactory functionable dental apparatus. Function is therefore the principal aim in treatment. The prevention and early recognition of malocclusion are the direct responsibilities of the general practitioner and the school dental officer, in fact what has sometimes been described as preventive orthodontics is primarily dental paediatrics. The dental practitioner's responsibility regarding the presence of malocclusion is just as important to the young patient as the detection of dental caries or other dental disorders. But his alertness in finding malocclusion will be of little avail to the patient unless there is an efficient national orthodontic service to which he can refer his patients for diagnosis and treatment.

AUXILIARY WORKERS

The part that dental technicians, skilled in orthodontic appliance making, dental attendants and oral hygienists can play in a national orthodontic scheme is considerable and their valuable contribution is worthy of mention.

The development in the techniques of new appliances of the removable type call for more training facilities for technicians. A well trained dental attendant can save valuable treatment time and no orthodontic department can function efficiently without her valuable aid. The services of an oral hygienist are probably more useful to the orthodontist than to the school dental officer, because the wearing of appliances demands a high standard of mouth hygiene and expert instruction to the patient is necessary. Important also is the clerical worker for no scheme can function smoothly without her aid.

PERORATION

In this peroration the proposals put forward to improve the orthodontic

facilities under the various schemes are reviewed. As regards the general dental service the availability of orthodontic consultants to assist private practitioners is of the utmost importance not only for diagnosis, and in special cases for treatment, but also for post-graduate education. The restriction in participation in the scheme to those practitioners with the necessary experience in orthodontics has been emphasized. It is recommended that local orthodontic committees be set up to select a panel of general dental practitioners who are sufficiently experienced to undertake orthodontics. It is felt that this restriction of orthodontic diagnosis and treatment to be undertaken by selected practitioners would do much to create greater confidence all round. Many dental surgeons hold the view that if there were a consultant orthodontist on the staff of the Dental Estimates Board it would make for smoother administration and it might materially help in reducing much of the inordinate delay which seems to accompany application for approval to carry out orthodontic treatment.

In the school dental service, participation in a consultant orthodontic service to be provided by Regional Hospital Boards would, I believe, be of great material help. The school dental officers would, like private practitioners, be able to take part in organised orthodontic post-graduate education.

The importance of having consultant orthodontists on the staff of large general hospitals has been dealt with, and with adequate training facilities for orthodontic registrars the future of a consultant orthodontic service would be assured, provided a sufficient number of trainees were forthcoming.

The existing four agencies for orthodontic diagnosis and treatment have been

considered. Each in its own sphere has its particular field of activity but these separate units could become more effective by active co-operation as recommended recently in a Ministry of Health Circular. The full integration of the health services, with the elimination of triple control, particularly of the dental services, will be difficult of attainment for many years. As there seems no prospect of this happening for some time there must be a policy of active co-operation by all concerned in the interests of the public and of the profession.

Some matters raised are controversial and will not pass without challenge, but there is one point on which there can be no dispute, namely, that for many years to come there will be too few orthodontists to cope with the needs of the child population. It is, therefore, important that we should harness our available resources to prevent dissipation of our energies into unorganised units. Finally, I should like to reiterate that an orthodontic service for the nation should be based on the consultant appointed by the Regional Hospital Board and not on the dental surgeon.

I hope I have given a fairly complete view of the whole spectrum of orthodontics and that it will not be long before we see an intensity of the colours.

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DISCUSSION

Mr. HAROLD CHAPMAN said the President's long experience, both of orthodontics and of the public service, was manifest in his very valuable address, which aroused thoughts on very many aspects of orthodontic work.

He would comment first on the statistics of the amount of malocclusion. It seemed to him that they were debatable. They depended on the views of the diagnosticians as to whether a passing phase was considered an abnormality. For example, Mr. Leighton had said that the ages of the children whom he and Professor Humphreys had examined were from 2 to 5½ years and that 27 per cent of them had postnormal occlusion. No one would say, from observation of the general adult public, that a quarter of the population required treatment for postnormal occlusion. The explanation might be that postnormality was a phase of the normal in many children in early life and that it changed to normal. If the term "post-normality" was used to describe this condition, it should be made clear that it was not or might not be a permanent abnormality. Moreover, there were degrees of this condition, some of the cases being so mild as not to call for treatment. Therefore he felt that the meaning of the statistics required very careful consideration. He would agree with the President that about 5 per cent of children required and benefited from prolonged treatment; he thought the percentage might be even less.

The President urged the members to harness their resources to create a more efficient orthodontic service. All must agree with that, but there was more to the problem, as the President had explained. Recently members of the British Dental Association had received a circular letter from that Association, pointing out the children's need for treatment to give them

healthy mouths and asking members to give this treatment in the National Health Service. This had come about because the school dental service was so under-staffed that it could not cope with the work. Surely the resources of orthodontists must be used to correct this state of affairs, as the dental treatment of children should have priority. When it was possible for every child to have a healthy mouth, then was the time for an enlarged orthodontic service.

The President suggested that most orthodontic treatment was done in the teaching hospitals, but he would have thought that much more was done in private practice, particularly in the general dental practitioner service, and that this would continue for a long time.

The President had outlined a scheme to develop and co-ordinate orthodontic services, with which there must be agreement, but it was an idealistic prospect at the present time, and could not be implemented in the immediate future. The consultants envisaged did not exist and, if they did, they could only carry out a small amount of treatment in addition to their other duties. Where were the others, orthodontists below the grade of consultant, to carry out the treatment? They had all to be educated and trained; they too, like consultants, must have experience, and that was a matter of time. The treatment of cases also was a matter of time; many took three years to complete and a further indefinite period was required before the ultimate result of the treatment was known. It was more than probable that only a very small proportion of the cases treated in the first year would be seen several years later, to enable a true assessment of the benefit of several years' work to be made. It was on these late results that the value of orthodontic treatment must be based. They provided the experience on which good judgement in prognosis was based, and it was obtained very slowly.

Treatment was not stabilised. What was practised to-day might be discarded to-morrow. It had taken Strang many years of practice—perhaps thirty or more—to discover that routine arch expansion was not successful and to substitute for it extraction combined with appliance therapy. Who was to say that this would not in its turn be superseded? Immediate results were easy. It was the long term results that were of value in teaching diagnosis. Orthodontists did not see enough of these or know enough about them. Progress is therefore necessarily very slow, and so the practice of orthodontics must develop slowly.

He would like to give two quotations which he thought he had given before, but as they seemed to be apt he thought that they would bear repetition. The first was from Adamson, of Melbourne, Australia, and was as follows: “What is the use of discussing methods of combating the ever increasing number of malocclusions if the profession is daily creating them in practice?” The second was from a paper by Gilbert, Gresham, Harding and Bliss, of New Zealand: “The scope of true prevention is reduced to preserving deciduous teeth.” He would also like to quote the following lines which had appeared in a newspaper in Philadelphia when he was a student there:

“Of all the many teachers
Doing business here on earth,
Experience is the dearest one,
But you get your money’s worth.”

In conclusion I would say *Festina lente*—“Make haste slowly.”

The President’s address was one to stimulate each member of the Society to ponder on the future of orthodontics, so that by their combined efforts the best solution as regards practice and treatment would be evolved for the benefit of their patients and the credit of their profession.

The PRESIDENT, in replying to Mr. Chapman, said he agreed that the statistics of the incidence of malocclusion depended

to a great extent upon the diagnostician. For that reason he had based the incidence rate for the general organisation of the scheme on a tangible index, as suggested by Miss Clinch.

It was unfortunate that he had omitted to state the ages of the children examined by Professor Humphreys and Mr. Leighton, which were two to five-and-a-half years. He agreed with Mr. Chapman that postnormality, so often seen in pre-school children, was a phase, and that was readily seen by the examination of serial models which had been taken over a number of years.

The main function of a dental service for children must be of a conservative nature, to achieve as many healthy dentitions as possible. If private practitioners and school dental officers unfamiliar with modern methods of orthodontic diagnosis and treatment undertook orthodontic work, they were wasting their time, which should be devoted to general dental treatment in order to increase the number of dentally fit children. A consultant orthodontic service would restrict the amount of treatment to that which could be undertaken by the specialist staff; in that sense treatment would be controlled. The consultant orthodontist had made up his mind to do orthodontia, and his time was therefore not lost to general treatment, because he would not have become a general dental surgeon.

If orthodontists waited until every child had a healthy mouth before they thought of a better orthodontic service, they would be doing a disservice to the profession and to the children. Recruitment to a profession was stimulated by the opportunities it can offer. A consultant orthodontic service would encourage some able men and women to think of it as a worthwhile career, and it might attract a number of suitable people to enter the profession who would otherwise not be attracted.

Orthodontic treatment could often prove of inestimable value to the child as a health

measure and also for aesthetic reasons which, of course, frequently affected health. In his opinion, orthodontists did not stress sufficiently the uplifting effect of orthodontic treatment on the health of the child. As they all knew by experience, an overcrowded mouth was prone to dental caries; contracted arches often caused some impairment of the respiratory mechanism, and generally speaking, pronounced postnormal dentitions caused much embarrassment to the host.

There were, of course, not enough orthodontists for the needs of the children, but if the demand was created the supply would soon catch up with it. That had been proved in the case of consultants in oral surgery and of dental teachers. The depressing evidence before the Teviot Committee had been that there was a serious shortage of dental consultants and teachers. Now, in 1953, less than a decade later, there were more trained senior registrars in oral surgery, fully capable of taking consultant appointments, who were unable to obtain posts in the hospital dental service. Some were so concerned about their future that they were entering private practice. Many more orthodontic consultants would be required than consultants in oral surgery, but the risk of redundancy was almost infinitesimal. He ventured to suggest that, if the opportunities for the training of orthodontists existed, in ten years' time there would be a considerable increase in consultant orthodontists, and there would be sufficient orthodontists to provide a satisfactory service for the nation.

Many orthodontic treatments took three years to complete, but that long treatment time might be due to the treatment being begun too early. He believed there were some orthodontists who were prepared to leave the start of treatment until the child was thirteen or even fourteen years of age and to endeavour to finish it within eighteen months or a little longer.

He agreed with Mr. Chapman that

orthodontic treatment, like medical treatment, was not a static quantity. What was done to-day might, of course, be discarded to-morrow. At the present time much surgery was being done in chest hospitals. Some chest physicians and chest surgeons felt that the pendulum had swung too far, but wherever it finally rested, experience will be gained in methods of treatment, and so it was with orthodontic treatment. Even if present methods were superseded in the near future, the experience gained to-day would stand orthodontists in good stead to plan their improved techniques of to-morrow.

Mr. Chapman had asked where and how those who were below the rank of orthodontic consultant were to work. The house surgeons, registrars and senior hospital dental officers would, of course, work in the dental department of the general hospitals, under the supervision of the orthodontic consultant.

In 1950, approximately 15,000 orthodontic applications had been approved by the Estimates Board, and he imagined that the total number of orthodontic patients treated in the dental schools and the Eastman Dental Hospital probably exceeded this total.

Dentistry was the Cinderella of the Health Service. Where dentistry was concerned the time was never opportune to advance its claims. Any proposed development would be greeted with "It is not the time," and so it would be shelved if orthodontists were not irrepressible and did not persevere with their claims. They should not let the *Festina lente* policy stifle their infectious enthusiasm for a scheme which they felt to be right in the interests of the children and of the profession.

He was very grateful to Mr. Chapman for his constructive criticism of his address.

Dr. W. G. SENIOR (Principal Dental Officer, Ministry of Health) said that he was very grateful to the President for giving him the opportunity to attend the present meeting, because orthodontics had

been a subject of concern to him since the 1946 N.H.S. Act came into operation. He thought that the President's estimate of 15,000 cases was now doubled, and it was true, as Mr. Chapman had said in opening the discussion, that the great majority of the work was being done by practitioners in private practice. He was interested in the President's suggestion that there should be a list or panel of orthodontists who would undertake the work, and it might seem strange that a Civil Servant should protest vigorously against a list, but under the old Dental Benefit scheme there had been a list of skilled anaesthetists and that had had a stultifying effect on the development of dental anaesthetics. Admission to the list was by filling up a questionnaire as to the number of anaesthetics that they had given. They had to be supported by a statement signed by a colleague, saying that they had done so many cases for him. This was a poor criterion as to ability and it had been exceedingly difficult for any young practitioner to get on to the list, subsequently; the list had become static.

He would very much prefer orthodontists to take their proper place among the specialists and have some hallmark indicating their ability to do orthodontic work. It would be necessary to persuade the profession that only the more simple cases should be undertaken by the general dental practitioner and that the complicated cases should be treated by the specialist.

He agreed with the President's proposal that there should be co-ordination so that the work could be very largely undertaken by the consultants in the hospital service, working in conjunction with the local authority. He assumed that the President's suggestion implied that the local authorities would have orthodontic treatment centres, which would be staffed by whole or part-time practitioners who were interested in that work, who would have available, to assist them, the services of consultants in the hospital service. This

was a most interesting proposal which should go far to solving a difficult problem.

With regard to the training of the orthodontist, that was not a simple matter. The members would be aware of the tragic position which had arisen on the medical and surgical side, when a large number of doctors went through the house appointments of registrar and senior registrar and then found that there were no posts available for them in the consultant service. There were still doctors who had been working for ten years on that ladder and were no nearer the goal of consultant level. He was very anxious to avoid that position arising on the dental side. The number of senior registrar dental appointments which had been approved was eighteen per annum, and that had been increased last year by nine, to provide for orthodontic senior registrar appointments. Therefore it might be assumed that, if hospitals took the trouble to make these appointments and fill them, there would be constantly nine senior registrar orthodontists in training.

He agreed with Mr. Chapman that everything possible should be done to prevent the need for orthodontic treatment. He could assure the meeting that he was doing his best in that direction at the Ministry, and the position was improving. The number of school dental officers was now only about sixty less than the number that had existed before 1948, but that was only a drop in the ocean, because about three or four thousand more dentists were needed to give a full time priority service.

He had very much enjoyed the President's address, which was broad in its conception and instructive in the appreciation shown of the administrative difficulties involved. He hoped that he would be supplied with a number of reprints for use at the Ministry.

The PRESIDENT said that he would like to thank Dr. Senior for his remarks and for the interesting points that he had raised.

With regard to the question of some sort of standard to be acquired by general dental practitioners before they could undertake orthodontic treatment, he had been thinking in terms of a local panel, on which the local dentists would be representatives from different bodies. In that way a more fair appraisal of an individual's ability would probably be obtained, and the difficulty which had arisen in the case of the former panel of anaesthetists would be avoided. He believed that this method had worked very well in obstetrical practice, where practitioners had been put on the list when it was known and proved they had had sufficient experience in midwifery, and he had been told recently that the method was still working satisfactorily.

He was glad to hear that there were now more senior registrars in orthodontics. That was a step in the right direction. He believed it was true that in medicine and in oral surgery there were too many consultants for the posts which were available, but if an orthodontic service was established on a proper basis there would probably be very little risk of redundancy because so many orthodontists would be required.

Mr. C. F. BALLARD said that he agreed with all that the President had said in his address, and he would like to emphasise two points.

It was stated in the Regulations that only that work should be done which was necessary for dental fitness. Orthodontists were not concerned only with dental fitness; they were also concerned with mental health, and much orthodontic treatment had to be done for the mental well-being of the patient. He believed that some orthodontic treatment had been refused by the Dental Estimates Board on the ground that it was not required for the purpose of dental fitness but only for the improvement of the patient's appearance.

He thought that in teaching the undergraduate the emphasis should be on

diagnosis. At the same time if undergraduates were to be shown how cases could be treated and how the end result benefited the patient from the point of view of functional occlusion and from the point of view of general mental well-being, there must be on the staffs of the teaching hospitals qualified orthodontists carrying out routine treatment, perhaps under the consultant on the staff. They might be junior consultants or hold appointments similar to the senior dental officers' posts. He thought that provision should be made for such people on the establishments of the teaching hospitals.

With regard to the scheme in Fife and the figure of 3,700 cases diagnosed in a year, that seemed a very large number but, from calculations which he had made, he believed that, if the dental surgeons presenting the cases knew what was required for a diagnosis and if there was a full ancillary staff, including a shorthand-typist, a consultant orthodontist could cover an even greater number from the point of view of making a diagnosis and directing the line of treatment.

Miss L. M. CLINCH said she would not like to think that orthodontic treatment did not help to produce a healthy mouth. In what Mr. Chapman had said there seemed to be a supposition that the aim must be to provide healthy mouths rather than to give orthodontic treatment, but it seemed to her that in very many cases orthodontic treatment was necessary in order to provide healthy mouths.

She thought that, with the small number of orthodontists that there were at present, the orthodontist could probably be used most economically in treating cases as well as diagnosing them. That might not be what consultants were supposed to do, but it had often happened in her experience that, when she had told a dental surgeon what was wrong with a case and what treatment should be given, she had found when she saw the patient again after six months that both her time and that of the

dental surgeon had been completely wasted. She still felt that, until there was a sufficient number of orthodontists, it would be better for the orthodontist either to teach students diagnosis or to treat orthodontic cases.

With regard to the question of cases being given orthodontic treatment to improve the patients' appearance, some mothers wanted treatment for a child who had a very slightly rotated lower incisor, on the ground that it affected the child's appearance. She thought that the Dental

Estimates Board was right in refusing to allow treatment for the purpose of appearance only.

She wished to emphasise that the important thing in orthodontics was diagnosis. She did not think the treatment could be shortened very much. Most orthodontists had a great deal of work to do and they were not likely to use a longer or more complicated form of treatment than was necessary. Provided that a case was diagnosed properly, it was not, as a rule, very difficult to treat it.

Medical Aspects of Malocclusion

HUGH R. E. WALLIS, M.D., M.R.C.P., D.C.H.,

*Consultant Paediatrician, Bath Clinical Area, Clinical Assistant (Research),
Bristol Children's Hospital.*

THIS INVESTIGATION started in Bristol four years ago at the suggestion of Professor A. V. Neale, Professor of Child Health in the University. It is an endeavour to find out how postnormal occlusion is caused, how it is connected with general health, with enlarged tonsils and adenoids, with chest diseases and deformities, with faulty posture and sucking habits.

Much has been said and written on this subject. To summarise the published work would take up a whole lecture, and I will not attempt to do so.

It was a pleasure to work in Bristol with Mr. Trevor Johnson, Mr. Nicol, Mr. Cousins, and Mr. Fairman, the E.N.T. Surgeon. We studied the following groups of patients: Maloccluded children attending The Bristol Dental Hospital, Normal Schoolchildren as controls, Children selected for tonsillectomy, Asthmatic children, Children who had been born prematurely, and University students.

Dr. G. Herdan, Lecturer in Statistics at Bristol University, kindly checked the figures for us and told us what was reasonably probable.

First we compared fifty postnormal children with fifty-two normal schoolchildren of roughly the same ages and social classes. Twins were excluded from both series because their inclusion would complicate the assessment of hereditary factors and birth weights.

HEREDITY

All parents were asked if any member of the family had a similar dental deformity. The parents of the normal control children were shown a selection of pictures of children with postnormal occlusion. The results of this enquiry are not really satisfactory because (a) the parents of children with the deformity are likely to have noticed it in their own relatives, and are ready to bring forward an explanation for their children being abnormal, and (b) the parents of normal children are loath to admit of any abnormality in their families, and also are not likely to have noticed it. On several occasions mothers replied, "Oh no, there's nothing like that in our family," when in fact they showed a marked degree of postnormal occlusion themselves as they opened their mouths to speak.

In the series of postnormal children 56% had at least one close relative affected. In the controls 19.2% only. This is statistically significant (Table I). Of the relations the aunt seems to be the most frequent sufferer (Table II).

Pregnancy, labour, and neonatal disturbances showed no differences between the two groups.

BIRTH WEIGHT

This was found to be lower in post-normal children, especially girls. Our

TABLE I
OCCLUSION AND HEREDITY

Occlusion	Sex	Number seen	Number with Hereditary factor	Percentage with Hereditary factor
Normal	Boys	29	5	17.25
	Girls	23	5	21.75
	Boys and Girls	52	10	19.2
Postnormal	Boys	25	13	52
	Girls	25	15	60
	Boys and Girls	50	28	56

TABLE II
DISTRIBUTION OF AFFECTED RELATIVES

Occlusion	Father Affected	Mother	Sibling	Aunt	Others
Normal	0	8	1	3	3
Postnormal	8	9	8	11	11

TABLE III
BIRTHWEIGHTS

	Normal Controls	Asher and F. Roberts	Postnormal	2nd Series	3rd Series	Total Postnormal
Boys (Number)	28	7	25	31	38	94
Mean Weight (Pounds)	7.2	7.60	7.57	7.28	7.60	7.49
Girls (Number)	23	?	23	20	42	85
Mean Weight (Pounds)	7.42	7.21	6.70	6.87	6.85	6.80

figures of mean birth weights were: Boys, 7.49 pounds; Girls, 6.80 pounds. Our controls were: Boys, 7.20 pounds and Girls: 7.42 pounds. Another series, probably more accurate, is that given by Asher and Fraser Roberts (1949), who studied 4,800 children. Their mean weights were: Boys, 7.60; and Girls, 7.21 pounds. They used the same method as I did, that of asking the mother the

birth weight. They proved statistically that this is just as accurate as research into past records (Table III). Looking at it from another point of view the number of premature babies was greater amongst the postnormals. A premature baby is defined by the League of Nations as one which weighs at birth five and a half pounds or less, regardless of the length of pregnancy. Adopting this definition, of

TABLE IV
INCIDENCE OF PREMATUREITY

	Normal Controls	Postnormal	2nd Series	3rd Series	Total Postnormal
Boys (Number)	28	25	31	38	94
Number Premature	3	2	4	5	11
Percentage Premature	10.71	8.0	12.9	13.15	11.7
Girls (Number)	23	23	20	42	85
Number Premature	2	5	2	2	9
Percentage Premature	8.70	21.75	10.0	4.76	10.6

TABLE V
FEEDING IN INFANCY

Occlusion	Sex	Number	Number Breast-fed at 6 months	Percent. Breast-fed at 6 months
Normal	Boys	29	18	62.1
	Girls	23	14	60.9
	Boys and Girls	52	32	61.6
Postnormal	Boys	25	9	36.0
	Girls	25	8	32.0
	Boys and Girls	50	17	34.0

all babies born in England and Wales in 1945 4.5 % were premature (Corner, 1952). In America in 1938 5.6 % of 258,525 babies were premature (Yerushalmy, 1938). Among the postnormal children we found; Boys: 11.7 %, and Girls: 10.6 % premature. Our controls had rather high figures. (Table IV) (Boys, 10.71 %; Girls, 8.70 %).

FEEDING IN INFANCY

Postnormal children were weaned earlier. At six months of age 66 % had been weaned compared with 38 % of the controls (Table V). At three months the figures were 36 % and 26.9 %. It is interesting to check one's figures against those of other investigators occasionally. An opportunity presented

itself when Dr. Ross and Dr. Herdan published an investigation into the decline of breast feeding in Bristol (1951). In the records for the years 1929–30 they found 22.8 % of babies were weaned at three months. My figure of 26.9 % for children born in the late thirties is fairly well comparable.

The results for feeding are statistically significant. You might wonder if the differences were due to the prematurity rates, as premature babies are more likely to be weaned early, either from their own weakness or from illness in the mother. However, if we cut out the premature babies from the tables there is

TABLE VI
FEEDING IN INFANCY (DISREGARDING PREMATURE BABIES)

Occlusion	Sex	Number	Number Breast-fed at 6 months	Percent. Breast-fed at 6 months
Normal	Boys	26	16	61.5
	Girls	21	12	57.2
	Boys and Girls	47	28	59.6
Postnormal	Boys	23	8	34.8
	Girls	20	7	35.0
	Boys and Girls	43	15	34.9

still a significant difference. (Table VI).

It has often been said that artificial feeding causes postnormal malocclusion, and you might think that I had proved it. What I think is far more likely is that children who are going to develop a post-normality have defects or succumb to illnesses which prevent successful breast feeding. Or it may be that mothers who produce postnormal children are inefficient at breast feeding.

VITAMINS

As far as could be determined there were no significant differences. We don't see severe cases of rickets nowadays, but this disease seems to be of little importance in the production of dental malocclusion.

SUCKING HABITS

These were considerably more common among the postnormal children. 60% of them had sucked a thumb, finger, dummy, or tongue for a year or more. In the controls only 21.2%. This may be slightly weighted by the fact that the parents of postnormal children like to find some reason for the abnormality, while the parents of the normal ones will not admit anything abnormal. An important point in the argument seems to me to be the report in *The Dental Record* by Townend (1950), of a pair of mono-

zygotic or identical twins, of whom one was a thumb-sucker and the other not, that "Marked differences in occlusal pattern were noted."

HISTORY OF ILLNESS

I expected to find a great difference here but I did not. Pneumonia, otitis media, whooping cough, and frequent coughs and colds were considered. There was no difference. The only differences were in the incidence of asthma and a history of snoring. 44% of the postnormal children had snored, but only 17.3% of the controls. This is linked up with the adenoids. The asthma I will deal with later.

TONSILS AND ADENOIDS

68% of the postnormal children had had their tonsils removed, and only 25% of the controls. Now tonsillectomy is an occupational risk of childhood. The greatest incidence of this mishap is at 5-8 years. If it were not for the year or two-year long waiting lists and the sabbatical three months imposed on the tonsillectomists by the annual poliomyelitis scare, this incidence would be considerably earlier. Early tonsillectomy may be a sign of severe obstruction. To quote one parent. Case 35. "His tonsils and adenoids were removed at Great Ormond Street when he was three because

TABLE VII
PHYSICAL MEASUREMENTS IN CHILDREN OF TEN YEARS

Occlusion	Sex	Mean Height (Inches)	Mean Weight (Pounds)
Normal	Boys	53.44	67.88
	Girls	55.31	69.41
Postnormal	Boys	55.56	65.25
	Girls	57.28	74.56

he couldn't swallow his own saliva." Case 46. "He had very large tonsils, and nearly choked twice before they were removed at three and a half." Most parents considered that their children were considerably improved by tonsillectomy and/or adenoidectomy. Often they stated that snoring ceased after the operation.

The fact that early operation was performed and that the obstruction was removed and yet the children developed or continued to have malocclusion seems to indicate that (whatever else it may do), tonsillectomy does not cure or prevent postnormal malocclusion. It might even be thought that tonsillectomy causes postnormality. This is unlikely because when we examined a group of children selected for operation before they were operated on we found that the malocclusion was more common among them than among normal controls. Mr. Nicol examined 274 such children on admission to the Bristol General Hospital, and of these 13.5% were Angle's Class II, Division I. Among 254 schoolchildren of similar ages there were 7.08% with a similar malocclusion, when seen by the same observer.

The most likely explanation seems to be that enlarged tonsils and adenoids and postnormality are both part of a general biological inferiority.

PHYSICAL EXAMINATION

The only important differences were in

the heights and weights. The postnormal children were taller than the normal ones. At ten years of age they were two inches taller, both boys and girls. At ten years also the girls are five pounds heavier and the boys two and a half pounds lighter. (Table VII). The incidence of congenital abnormalities seemed to be greater in the postnormal cases. This was especially so with regard to nasal polypi and bony abnormalities such as cervical ribs and enchondromata. Chest deformities were slightly more common in the postnormals. These differences were not statistically significant. The importance of this is that if there is one congenital abnormality present it makes it more likely that the defect we are studying is also of congenial origin. (Table VIII).

ASTHMA

Asthma seemed to be more common among the postnormal cases. This might have been because some of the children in the series had been referred to Mr. Trevor Johnson from Bristol Children's Hospital where they were undergoing treatment for that condition. On the other hand children at an elementary school might not be a true representative sample in this respect as the severe cases of asthma would tend to be sent to open air schools. We accordingly turned our attention to a group of asthmatic children. Dr. Beryl Corner very kindly allowed us to examine children attending her asthma clinic at Bristol Children's Hospital. Mr. Cousins classified

TABLE VIII
MISCELLANEOUS ABNORMALITIES

NORMAL BOYS	POSTNORMAL BOYS
Urticaria and Hay Fever	Talipes
Migraine	Eczema
Torticollis	Tongue tie
Abnormally long Uvula	Nasal Polypi (two cases)
Undescended Testicle	Pyloric Stenosis
Inguinal Hernia	
NORMAL GIRLS	POSTNORMAL GIRLS
Intussusception	Squint
Eczema	Exostosis on Femur
Pectoralis Muscle Missing	Prolapsed Rectum
	Enchondroma
	Bronchiectasis
	Eczema

TABLE IX
BIRTHWEIGHTS OF SELECTED POSTNORMAL CHILDREN
WITH NO HEREDITARY OR SUCKING FACTOR

SEX	NUMBER	MEAN BIRTHWEIGHT (Pounds)
Boys	15	7.09
Girls	14	6.54

them according to their occlusion. We saw seventy-three cases, and of these thirty-four or 46.6% were normal, thirty-four postnormal, 46.6%, and five or 6.8% prenatal. The incidence of both post- and prenatality is much above that in the general population. It can be concluded either that chronic asthma causes dental abnormality or vice versa, or that they are both part of a chronic dysfunction or general physical inferiority.

MULTIPLICITY OF CAUSAL FACTORS
It seemed now that we had found

postnormal malocclusion to be due to many different factors, of which the two strongest were heredity and sucking habits. In an attempt to elucidate the matter further I started to collect cases in which there was no hereditary factor admitted, and who had never had abnormal sucking habits. This was difficult as such cases are not very common. However, twenty-nine cases were mustered, fifteen boys and fourteen girls. These children did not show any very great difference from the postnormal series, but their birthweights were even lower. Table IX. (Boys 7.09,

Girls 6.54). Not quite so many of them had lost their tonsils, and rather more had chest deformities.

PREMATURITY

The next thing we attempted was to see a large number of children who had been prematurely born and to find out if they had an increased incidence of any type of malocclusion. May I remind you of the definition of prematurity, p. 520. The Chief Medical Officer for Maternity and Child Welfare of Bristol, Dr. Sarah Walker, kindly let me have a list of seventy children born in 1946 who had been five pounds or less at birth, and who were still living. Of course this is not a true representative sample of all premature babies born as quite a large number would have died. Corner (*loc. cit.*), states that of 445 premature babies born in Bristol in 1945, 105 died within four weeks (24.6%). She also notes that of those born at home nearly 50% died within four weeks. This is of importance in my argument later. I invited all seventy to come to the Dental Hospital for examination. Only thirty came. The other forty either could not spare the time, or did not reply. That possibly invalidates the whole investigation. It might be that the ones who did not reply were perfectly healthy and normal and just did not want to go near a doctor. It may have been that they were the weakly ones who had had so much hospital treatment that they would never go near a doctor again if they could help it.

Among the premature children who did attend we found that post-normality was much more common than among the controls. Mr. Nicol examined them all, and found 30.0% postnormal, compared with 9.44% for unselected schoolchildren of the same age. This was the sort of proportion that we expected, and, assuming that we saw a fair sample, it shows that prematurity is an important factor in postnormal malocclusion. The other factors, sucking habits, heredity, illness, etc., showed no significant differences. The only one was that toxæmia of pregnancy was more common in this series. This is natural, as toxæmia leads to prematurity, either by surgical interference aimed at saving mother's life, or by natural early termination of pregnancy. Five of the thirty mothers had a history of toxæmia, compared with one in fifty-two of the controls. Only one of these five had a post-normal child. This suggests to me that postnormality due to or associated with prematurity is not due to toxæmia. Prematurity may be due to toxæmia or to other causes. If post-normality were due to a mere early appearance on the stage then it would be found just as commonly in the children whose early appearance was due to toxæmia. This was not so (Table X), so we can discount any idea that postnormality is due to deficient growth of bones in the early life of the premature baby. This might be studied in more detail in the future. My figures are too small to be certain about it. I feel that it is most

TABLE X
MATERNAL TOXAEMIA AND OCCLUSION OF PREMATURE CHILDREN

	Number of Children	Number with Normal Occlusion	Number with Post-normal Occlusion
Maternal Toxaemia	5	4	1
No Maternal Toxaemia	25	17	8

likely that there is one cause or set of causes for both prematurity and post-normality.

If we could classify the occlusion of newborn babies we might be able to elucidate the point. I was interested to read Miss Clinch's study of newborn babies (The Dental Record, 1933). Miss Clinch very kindly looked out for me the records of the birth weights of the hundred children she described there. I worked out the average weights of the different classes, and was disappointed to find no difference in them. However, on looking into it further I found that there were no children of less than five pounds eight ounces, and indeed only one of less than six pounds. Perhaps the premature infants were kept in a separate nursery. It would be interesting to follow some premature infants from birth to adult life with serial models.

UNIVERSITY STUDENTS

Next we turned our attention to an older age group. At that time I was medical officer to Bristol University Health Service. All the undergraduates were examined once a year, and I saw 482 of them. I classified them into normal, postnormal, and prenatal according to

the occlusion of their canine teeth, as Humphreys and Leighton did in their investigation (1950).* At the end of the year I was able to compare the three groups for a large number of characteristics, with most interesting results. I excluded all foreign students and a few who had lost essential teeth or had dentures. This left me 433 students (316 men and 117 women). The incidence of the types of occlusion was as in Table XI. Totals: Normal, 61.6%; Postnormal, 32.9%; and Prenatal, 5.5%.

Are these different from the general population ? Figures for the incidence of malocclusion vary, and it is difficult to get a good unselected sample. Generally figures are about 25% postnormal and approximately 1% prenatal. The university students show an increase in both post- and prenatality. The increase in prenatality is considerable. May we assume that prenatality conveys greater intelligence, or perhaps greater deter-

*In the lecture a reference was made to Humphreys' and Leighton's paper, and a figure quoted for the incidence of postnormality in the parents of children attending Infant Welfare Clinics. This was 36.7%. Mr. Leighton has pointed out an error in this calculation and has very kindly worked out the correct figure. It should be 34.9%, which is very close to the 32.9% found among the students as a whole.

TABLE XI
OCCLUSION IN UNIVERSITY STUDENTS

		Normal Occlusion	Postnormal Occlusion	Prenatal Occlusion	Total
Men	Number	197	100	19	316
	Percentage of Total	62.4	31.6	6.0	100
Women	Number	70	42	5	117
	Percentage of Total	59.8	35.9	4.3	100
Men and Women	Number	267	142	24	433
	Percentage of Total	61.6	32.9	5.5	100

TABLE XII
OCCLUSION OF STUDENTS IN VARIOUS FACULTIES AT THE UNIVERSITY
(Men and Women together)

		Normal Occlusion	Postnormal Occlusion	Prenormal Occlusion
Arts, Law, and Theology	Number	88	41	6
	Percentage	65.2	30.4	4.4
Science, Engineering and Medicine	Number	109	59	13
	Percentage	60.2	32.6	7.2
Medicine alone	Number	15	5	1
	Percentage	71.5	23.8	4.7
Dentistry	Number	5	4	0
	Percentage	55.6	44.4	0

TABLE XIII
HEIGHT AND OCCLUSION OF UNIVERSITY STUDENTS
(Mean height in centimetres)

	Normal Occlusion	Postnormal Occlusion	Prenormal Occlusion
Men	174.77	176.24	174.73
Women	162.56	164.95	163.60

TABLE XIV
WEIGHT AND OCCLUSION OF UNIVERSITY STUDENTS
(Mean weight in kilogrammes)

	Normal Occlusion	Postnormal Occlusion	Prenormal Occlusion
Men	69.23	67.71	71.05
Women	59.23	59.12	65.20

mination to reach the top and pass examinations.

We worked out the incidence of occlusions in various faculties, and found no very startling differences. There was a tendency for prenatal students to choose science more than arts, but it was not very great (Table XII).

I considered a number of physical factors. Some of these showed no differences at all, such as hair and eye colour and myopia. The heights and weights are

shown in Tables XIII and XIV. These show that both men and women postnormals are taller than normals, and also lighter. Men are half an inch taller and women nearly an inch. Postnormal men 3.3 pounds lighter and women very slightly lighter. Prenormal men no difference in height, but four pounds heavier. Prenormal women one centimetre taller and 13.2 pounds heavier. What makes people taller ? First heredity, racial and familial. Second, nutrition. The

TABLE XV
SITTING HEIGHT AND OCCLUSION OF UNIVERSITY STUDENTS
(Mean height in centimetres)

	Normal Occlusion	Postnormal Occlusion	Prenormal Occlusion
Men	92.01	92.22	93.44
Women	87.46	87.59	85.15

TABLE XVI
DISABILITIES AND OCCLUSION IN UNIVERSITY STUDENTS

Disability	Percentage incidence of each disability among students with:		
	Normal Occlusion	Postnormal Occlusion	Prenormal Occlusion
Myopia	26.2	26.0	29.2
Appendicectomy	3.74	6.34	4.16
Asthma	0.375	4.23	4.16
Chest Deformity	13.85	21.17	20.8
Deviated Nasal Septum	0.75	2.82	0.0
Flat Foot	5.99	8.46	12.7
Hammer Toes	1.5	4.23	4.16
Hernia	1.5	2.82	0.0
Otitis Media	6.0	9.16	8.34
Systolic Murmur	21.0	28.9	37.5
Varicose Veins	0.75	1.41	0.0
No Disability	22.5	10.58	20.8

height of children in this country is gradually rising at any given age so that the tables of averages in the books are always out of date. This is due to improved nutrition. Thirdly, late closure of the epiphyses, which is linked up with sexual development. The earlier the sexual development the earlier the closure of the epiphyses and the earlier the full stop to growth in height, and vice versa. I worked out the sitting heights of some of the students, and these were very little different, showing that the increase in height is in the legs, which is after all where the main

growth takes place. (Table XV.) Table XVI shows several factors and their percentage occurrence in the three groups of occlusions. Note first that myopia is equally common in all three groups. We can conclude that it has no connection with the occlusion. There are a number of other factors that are also equally common. I have not put them in the table, but they are: hair and eye colour, skin and heart disease, migraine, hay fever, history of pneumonia, dysmenorrhea, and the age of onset of menstruation. The disabilities are listed in

alphabetical order. You see that every one is slightly more common in the maloccluded, except for deviated septum, hernia and varicose veins in prenormals. The figures are not statistically significant in the academic sense of the term when taken by themselves in each line of the table, except for chest deformity and asthma. But, adding them all together they are statistically significant. It is easier to do this by subtraction. Consider the last line, the numbers of students who had none of these various deformities. The normals have 22.5% and the postnormals only 10.58%. This is a highly significant difference. It seems to underline a general biological inefficiency in postnormal cases. The prenormals are not much different, 20.8%. The incidence of tonsillectomy in the various occlusal groups confirmed what we had found in children. Normals 34.5%, postnormals 47.2%, and prenormals 41.6%.

When the examination results were known I worked out the percentages of each class of deformity in each class of honour, and there were no significant differences. In passing I found that those who failed their final examination had a higher tonsillectomy rate. (Table XVII.) Of those who passed 32.8% had had their tonsils removed, and of those who failed 60.0%.

DISCUSSION

Now I think that I have proved a general biological inferiority and a high incidence of prematurity in postnormal cases. Where

does that lead us, or rather, where have we been led to? Postnormality is becoming, as Mr. Hovell says, a British National Characteristic. It has become so through the process of unnatural selection of modern civilisation. In Berlin in 1881 the infant mortality was 200 per thousand. Of every thousand children born alive 200 died in the first year of life. In the middle ages this mortality was very much higher, perhaps 500 per thousand, or even more. Can we doubt that the ones who perished were the premature, the weakly, the postnormal? Miss Smyth, (1933), has published a fascinating account of the Anglo-Saxon skulls found in a cemetery at Bidford-on-Avon. She found very few postnormal cases: most of the skulls had an edge to edge bite. It has been concluded from this that the occlusion of the race is changing. That may well be so as far as adults are concerned. But the graveyard did not contain a true representative sample. There were no premature babies in it, indeed very few infants and children. Of all the children who were born in those days, how many survived to adult life? Perhaps ten per cent. Suppose that all the postnormal ones died young, that would make the adult cemetery appear like a collection of normal and prenormal people, which is what it seemed to Miss Smyth. Also possibly prenormality was an advantage in the struggle for existence in those times. It seemed to be more common in university students, presumably the more intelligent members of the community.

Does it matter? Some say that it is an

TABLE XVII
TONSILLECTOMY AND EXAMINATION RESULTS

Result of Examination	Number of Students	Number who had Tonsils removed	Percentage who had Tonsils removed
Passed	320	105	32.8
Failed	20	12	60

advantage in the marriage market for a girl to be postnormal (cf. the discussion on Humphrey and Leighton's paper). On the other hand are we in danger of producing by our unnatural selection a race of asthmatics with enormous tonsils and adenoids?

What can we do about it? Brash pointed out that we can't treat all the children. Humphreys and Leighton reckon that there are one and a half million postnormal children in the country. We must try to prevent it occurring. The only way to do this is to stop caring so well for premature babies, or alternatively to breed from prenormals only. A few pictures to show how people who marry are alike in facial configuration. (Assortative mating).

ENVOI

Lastly I was interested to read in The British Medical Journal a few months ago a letter from Dr. Kathleen Vaughan (1951), which starts as follows: In Praise of Breast Milk. "Sir,—For several years now I have carefully studied the faces, especially the jaws, of the Oxford and Cambridge boat-race crews, and I think I can tell the winners beforehand The well-developed jaw and teeth, etc., etc. . . . I put this down to breast-feeding by a healthy mother Our great leaders of the past were fed on fresh human milk etc., etc."

Well, Mr. President, we have been wasting our time. We should have been studying the occlusion of race horses. We are advised not to look a gift horse in the mouth. Perhaps that is the first thing we should do, and ask it to bite its back teeth together. Or maybe we should enquire if it was udder-fed. Also I must now approach a milk manufacturing firm and get them started on making Grand National Dried Milk.

SUMMARY

An investigation has been made into the relation of malocclusion, particularly postnormality, to general health and disease. It is concluded that:

(1) The hereditary factor is of great importance.

(2) A low birth weight, indicating a degree of prematurity, is associated with postnormality.

(3) Artificial feeding is more common in postnormals.

(4) Sucking habits have a strong influence on the development of malocclusion.

(5) The removal of tonsils and adenoids is closely connected with postnormality.

(6) Asthma is associated with malocclusion.

(7) Postnormal children and university students are taller than normal.

(8) Minor disabilities are significantly more common among postnormal university students.

(9) It is suggested that postnormality is associated with a general biological inferiority.

ACKNOWLEDGEMENTS

I wish to thank the following persons who have helped in the investigation or given advice and encouragement: Miss L. M. Clinch, Dr. Beryl D. Corner, Mr. F. C. Cousins, Mr. H. D. Fairman, Dr. G. Herdan, Prof. H. F. Humphreys, Mr. W. Trevor Johnson, Sir Arthur Keith, Mr. B. C. Leighton, Prof. A. V. Neale, Mr. W. Nicol, Prof. R. H. Parry and his staff, and Miss K. C. Smyth.

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DISCUSSION

Miss L. M. CLINCH said she had found Dr. Wallis's paper most interesting in more ways than one. One was apt to speak glibly about an orthodontic case being due to the obvious cause; for example, thumb-sucking or heredity (when the parent accompanying the child presented the same deformity). Where there was no obvious cause, one either ignored the question of aetiology or made a guess which coincided with one's preconceived ideas on the subject. It was therefore refreshing to hear an analysis of a large number of groups of patients in which the heredity, medical history and habits were tabulated. Dr. Wallis was entitled to speculate for he had certainly accumulated even if he had not spotted the lady. That would be too much to hope for, as it would appear that there was more than one lady present. It was extremely difficult to get an accurate history of heredity. Parents varied from those who said: "I don't want her to go through what I did at school" to those mentioned by Dr. Wallis, who appeared to be quite unaware of a very glaring malformation.

As regards feeding in infancy, she certainly agreed that the reason for the early weaning of postnormal children was that successful breast feeding was difficult. She had known cases where the postnormality was so pronounced that breast feeding was impossible, and she had never been able to find any difference in the occlusion between breast or correctly bottle-fed children.

The effect of sucking habits was difficult to assess. She was not convinced that a habit alone would change a potentially normal occlusion into a true postnormal occlusion. Undoubtedly an abnormal incisor relationship could be produced which might, to outward appearance, be similar to a postnormal occlusion, or a narrowing of the upper arch might result in a trans-

verse malocclusion of the molar teeth. From clinical observation, which though misleading at times could be valuable if one was not made with a one-track mind, she would say that sucking habits did the maximum damage if there was a congenital postnormal occlusion present. If Dr. Wallis could show that the percentage of postnormal occlusion was as high in cases where there were sucking habits but no heredity malocclusion, she would be proved wrong, but luckily he had not done so—so far.

It was interesting to find that the percentage of prenormals as well as postnormals was greater in asthmatic children. Of the eleven asthmatics she had under treatment at present seven were postnormals, two prenormals and two had subnormal dental arches but normal antero-posterior arch relationship. However, the two prenormals had very subnormal maxillary dental arches and normal mandibular arches, so that the prenormality appeared considerably greater than it really was. Sometimes these cases were very difficult to diagnose, and it might be more accurate to call them postnormality of the maxilla. This was more what one would expect to find as part of a chronic dysfunction associated with asthma.

Of all forms of malocclusion, children seemed to benefit most in health from the correction of postnormal occlusion. It was sometimes striking to notice the difference after six months of intermaxillary traction (with any efficient form of appliance). And parents frequently commented on the improvement in appetite and the reduction in colds and minor illnesses. The remark, "He is a different child," summed it up. She was interrupted at this point, while making notes for the discussion, by a patient whose antero-posterior arch relationship had changed from postnormal to normal during the past six months. He had

put on 7 lb. in weight during the last school term.

The definition of premature birth which depended on the weight and ignored the time factor (or length of pregnancy) surprised her. The definition of prematurity in the Shorter Oxford Dictionary was "occurring, existing or due before the proper time." She would like Dr. Wallis to say why this definition was used.

However, the association between post-normality and prematurity was a very valuable observation. As Dr. Wallis said, it seemed that there was one cause or set of causes for both conditions. She would like to ask Dr. Wallis if the standard of general health was lower in later life in individuals born prematurely. Up to a point, one could classify the occlusion of new born babies, though in saying this she was asking for trouble. Sillman, who had done more work on serial models from birth than anyone else did not agree with her because he said there was no occlusion at birth. She knew, of course, that the tongue lay between the pads, but she thought there was a definite antero-posterior arch relationship, just as there was a free way space and a definite arch relationship in the adult. It would be valuable to examine a number of premature babies and to compare them with a similar number of normal babies to see if there was a difference in the relationship of the gum pads. She was sorry that her Rotunda infants did not help Dr. Wallis: but she doubted if one found either as many or as marked post-normals in Dublin and apparently one also found fewer premature babies.

She would like to thank Dr. Wallis for his most interesting and stimulating paper. She was convinced that if only the paediatrician and the orthodontist could get together one would learn much about the causes and results of malocclusion and in this paper Dr. Wallis had taught her a great deal.

Dr. WALLIS said that one occasionally saw in the nurseries babies who could not

suck due to a very small lower jaw which was called micrognathos. In some cases the disability was so bad that they had to be nursed on the front, so that the tongue did not fall back and choke them. The asthmatics should probably be attacked in more detail, and prenormals would be studied next to see where that led to.

It was difficult to be certain that a child had gained in health owing to treatment unless there were controls. Fortunately, parents were apt to put down any improvement to the treatment given, and he did not say it was not the case, of course. But sometimes an increase in weight might be due to Christmas, or something of that kind, and there ought certainly to be controls.

A premature baby had been defined by the League of Nations as one weighing 2,500 grams or less, however long the pregnancy; and who was he to argue with the League of Nations !

The development of premature children was on the whole slightly below normal for a long time, especially in height and weight. Apart from that, they were more liable to be mentally backward because some of them suffered from birth injuries, such as cerebral damage, because they were so small and could not stand the strain, and because they might suffer from anoxia after birth.

PROFESSOR A. V. NEALE thanked the Society for inviting him to attend the meeting.

He thought the most useful contribution he could make to the discussion would be to go into a few generalities. Miss Clinch had mentioned the importance of teamwork. The more he studied and taught medicine and played some responsible part in training the future generation of doctors and—to a slight extent—dental surgeons, the more he realised that there was hardly any dividing line between medicine and dental surgery. There was merely a convenient division of labour—more or less unequal in regard to

financial reward, but that did not matter from the scientific point of view.

There was no doubt at all that more interest must be taken in genetics. Dr. Wallis had pointed out that this was an age of anti-Darwinism. An unnatural unselected group of human beings was being evolved. It might well be, therefore, that the financial gain in the future—the job to make money—would be in orthodontics. People were being kept alive who otherwise would undoubtedly not live except for safer obstetrical procedures, special care of the new-born, particularly premature babies. Penicillin, running right through the whole gamut of antibiotics to terramycin was now commonly saving life.

This was linked up with ethics and philosophy and it was a dangerous subject to discuss, but there was no doubt that a change was taking place in the overall picture of human beings. The orthodontic affair was one change, and there were many others.

He played some part in teaching dental students in Bristol, and he was very glad to do so. He had spent twenty-five years at the job and he had always been interested in getting into the mind of the dental student in his undergraduate years (when they were qualified they were not so easily approachable) the idea of the joint function of the doctor and the dentist. He should go on doing that, because the dividing line was nil, and the more one understood the interrelationship of these people the better. It could not be more important, for instance, than in the field of orthodontics.

One could take any disease one liked—asthma, eczema, or even ingrowing toenails—and the more one thought about it the more complex it became. Medicine twenty-five, thirty or fifty years ago was relatively simple straightforward textbook stuff. Now it was entering a field where underlying constitutional factors were being given much thought. He hoped the

discussion this evening would open people's eyes once again to a problem which had not yet been solved—namely, why these things happened in some and not in others and how and why and where they were related to more general problems of health and illness.

To assess a child in health or disease was often a very difficult problem, but it was constantly being forced upon one. The school health service would say "examine" but he himself preferred "assess," which meant a composite study of the body and of the mind in the same person at the same time. For instance, take the child with a severe orthodontic problem. Was it not possible that the child who was visibly physically unattractive might, by virtue of leg-pulling and other matters, go into a mild form of neurosis? That, as everyone was aware, was a very strong trigger for the bronchioles to go into spasms of what was called asthma, or to cause a skin irritation which might be called eczema.

In thirty years' clinical work, he had come almost round the circle to the appreciation that mental health was very intimately related to physical problems, as to both cause and effect. They could not be divided. Any doctor or dental surgeon needed to be his own psychologist up to a point. This did not mean using complicated language, but applying common sensible psychology as part of his everyday activity. If he could not do that, he was not fit for anything except to be a technician, which was a pity.

Miss Clinch had introduced this idea in her short contribution to the discussion. Naturally she had vested her interest in her work, and by knowing the individual psychology of every patient, she was able to make a greater success in the special and general treatment.

Knowledge of vitamins and nutrition had been improved and many of the gross problems of the past, such as rickets and scurvy and other nutritional abnormalities,

had been cleared up. There had, however, emerged a residue of genetic problems. Fifty years ago orthodontic abnormalities were often called rickets, he felt sure, though he did not know. Certainly nearly all chest deformities were called rickets in those days. They were all put together and thought to have a common cause. He had not himself seen any rickets worth talking about for several years and it must now have become very rare. As a practical matter, therefore, there was a changing scene in the picture of medicine, particularly with children. There was this strong move towards mental health, and a strong move towards a greater recognition of minor deviations from normality of which the jaw was one particular aspect.

Miss Clinch had asked about the definition of the premature baby and Dr. Wallis had mentioned the League of Nations agreement on a standard in weight. In studying prematurity one must recognise that 75 to 80 per cent of the literature of the past was hardly worth the paper it was written on, for the simple reason that many a baby $5\frac{1}{2}$ lb. at birth had lived the usual length of intra-uterine life. Length of pregnancy must therefore be taken into consideration as well as actual birth weight. Many brilliant people entered the world as premature babies.

Prematurity was a relative term and there were many people with a low birth weight and a full gestation period who perhaps never became heavyweights but by virtue of living in a state of physiological economy lived longer, better and safer than some others and perhaps did not need to pay extra premiums on life assurance. On the other hand, there were plenty of babies born at thirty-four weeks' gestation whose weight was perhaps 4 lb. 7 oz., and they merely accidentally antedated their birthday for some unknown reason. 50 per cent of all premature births were idiopathic, that is to say there was no reason whatever as far as one could see. All the factors must be considered very carefully.

Possibly orthodontic problems might be bound up predominantly with a low birth weight at the full gestation period or near it.

He was very pleased to be at the meeting and to make a small contribution to the friendly and mutual interests of the dental and medical profession.

Dr. WALLIS said he had not included twins in the paper because they were liable to have low birth weight, even though not premature.

It was very difficult to be sure about the length of pregnancy, because some people got their dates mixed up or did not remember them. He thought that was what the League of Nations had in mind in fixing a weight standard.

Mr. GORDON TAYLOR said that Dr. Wallis seemed to be putting forward the suggestion that postnormal occlusion might be a mutation. In the past, it was a pretty lethal mutation, because it was accompanied by a great many physical drawbacks. But as Professor Neale had pointed out, the physical drawbacks were being overcome by advances in medicine and surgery, so that these mutations were now becoming not lethal but more successful.

In particular, he had been struck by Dr. Wallis's figures for the number of pre-normal occlusions at the University, which was higher than the average. One had to remember too that some of his normal occlusions might have been born abnormal but were corrected by orthodontic treatment. Possibly this might be a mutation with a better brain capacity, and Mr. Chapman's final suggestion about longevity brought one to Bernard Shaw's idea of Methusaleh. Might one not be seeing the start of an advanced race of the future? He realised he was rushing Dr. Wallis's fences, but he would like to know how these ideas struck him.

Dr. WALLIS said the idea of mutations was interesting. The trouble was, what was desirable? Did one want the whole

race to consist of Aldous Huxleys (with apologies to Aldous Huxley) ? Would it be a good thing if everybody was a Beethoven ? Was it not perhaps as well to have some of every thing ? One needed a few dustmen.

He had not mentioned that some of the University students were cut out of the investigation because they had dentures or did not have the right sort of teeth meeting: they had had them removed. A few had had treatment and he had classified them according to what they were before the treatment started.

Mr. BALLARD congratulated Dr. Wallis on his very valuable and extensive work. If he himself had reached such a stage in an investigation, he said, he would like to break down these Class II, Division 1, cases into various types. From his own observations in America, he had come to the conclusion that Class II, Division 1, could be broken down into two broad groups from the point of view of the general morphology of the head and neck.

There was the typical anglo-saxon face which tended to have a high gonial angle and a low hyoid bone, with the tongue rather lower down and possibly with a postnasal and postaural airway which was narrow. The Central European and perhaps the American postnormal types had a shorter face, longer in front of the ear, with a lower gonial angle, a much larger and wider maxilla and a longer mandible antero-posteriorly, although still postnormal to the maxilla.

He wondered whether such a group would show the same features, and whether Dr. Wallis's figures represented not so much a distinct Class II, Division 1, malocclusion but postnormal occlusion as a distinct type of growth. He disliked using the word "ectomorphic" but that was the type that came to mind.

Would it be worth while, in continuing the investigation, to break down postnormal occlusions into various morphological types ?

He entirely agreed with Dr. Wallis's general conclusions, and in support of them he would like to quote from what Professor Hooton said in "Evolution and Devolution of the Human Race";

"Thus man patches up and preserves deteriorated human organisms and by the bounty of charity encourages them to proliferate and perpetuate their germinal defects and their sheer evolutionary pauperism."

Mr. HOVELL said he would like to suggest a different method of breaking down Class II, Division 1. Incidentally, he assumed that Dr. Wallis had used the incisor relationship in deciding whether to call cases normal or postnormal, and not the molar relationship.

Mr. Rix had shown definitely that a very large number of cases of postnormal incisor relationship of the Class II, Division 1 type were due to faulty swallowing with a tongue thrust. These cases could therefore be divided into (a) Those with an abnormal swallowing pattern; (b) Those with normal swallowing action.

He wondered whether an abnormal swallowing action with a tongue thrust that had produced a Class II, Division 1, incisor relationship also resulted in an inadequate postnasal drainage, with the result that children who suffered from malocclusion would also suffer from upper respiratory disease. Might this not account for the association which had been noted between Class II and upper respiratory disease ?

If one broke down Class II, Division 1, malocclusions in this way and worked out the association with infected tonsils and adenoids one might obtain information valuable to the paediatrician as well as to the orthodontist.

Dr. WALLIS said that Mr. Trevor Johnson had classified the children, so that let him out. The students were classified by the canines. Abnormal swallowing would, he thought, have to be looked at again.

Mr. LEIGHTON congratulated Dr. Wallis on a most comprehensive survey.

He asked whether Dr. Wallis examined the relations of the postnormal children when he assessed the hereditary factor or whether he went by what the mothers told him.

Secondly, he was not sure whether he had correctly understood the composition of the control group. Were they obtained from a different source from the postnormal group, and if so were they strictly comparable? Particularly, might this apply to the premature babies? One set of figures related to Bristol in 1945. Were the abnormal patients born in the same year or in different years?

Finally, figures were quoted for the parents of the children and there was 36 per cent postnormality among them. If he remembered rightly, that figure was made up of all the parents of all the children who were seen. There was a certain amount of artificial selection there. These parents were 50 per cent parents of normal children and 50 per cent parents of postnormal children. To be a random sample 25 per cent should have been parents of postnormal and 75 per cent of normal children.

Dr. WALLIS said he was sorry he did not examine the relatives, but life was too short! He took what the mothers said. The normal controls were chosen at an ordinary school medical inspection and Mr. Nicol was there. He said this one was normal and that one postnormal, and no notice was taken of the postnormal ones. They were not strictly comparable because they came from four schools, whereas the postnormals came from all over Bristol.

The premature babies he saw were born in 1946 and the others in 1945.

Mr. ENDICOTT said he greatly admired Dr. Wallis for the vast amount of work he must have put into preparing such a valuable paper. At the outset, he mentioned posture but he did not deal with it later. Had he any observations to make in

regard to posture and postnormal occlusion?

Dr. WALLIS said it was easy to say a child had poor posture and yet how could it be proved? It could not be measured. He had the impression that posture was worse in some of the postnormals but he could not prove it statistically.

Mr. LEECH said that Dr. Wallis had shown the relationship between thumb-sucking and malocclusion and Professor Neale had emphasised the relationship between malocclusion, the health of the mind and the health of the body. The psychiatrist said a child should not be forced to give up the habit of thumb-sucking, so there seemed to be a vicious circle. What were the views of Dr. Wallis and Professor Neale?

Mr. J. H. GARDINER said he had found a higher percentage of children with Class II conditions resulting from thumb-sucking amongst the physically inferior. It had often occurred to him that a child with a low muscle tonus might have its mandible influenced more by a thumb-sucking habit than a child with good muscular development.

Dr. WALLIS said the answer was no. He had divided the children into those who sucked and those who did not suck their thumbs, but there was no difference.

Professor A. V. NEALE asked whether thumb-sucking ever caused dental abnormality. He was asking for information. Thumb-sucking was one of those things that was passed by as most elementary, as something one could do nothing about. It was really a tremendously deep and psychological subject, which was wrapped up with the individual personality of the child and was worthy of the deepest consideration.

There were many subjects that medicals and dentals—and particularly medicals—had assessed in the past as of no importance and not worth bothering about. One was now at least enquiring into the fundamentals of common things like

thumb-sucking, and one found one knew very little about it. It was a deep psychological disorder. It gave insight, perhaps, into the family set-up; or it might be related to frustration during the early period of feeding. It was difficult for people of ordinary brains like themselves to understand that a child of seven was perpetuating a symptom from very early infancy.

Thumb-sucking was not one of the things one could cure. One had to find the primary relationships. Children had particular personality pictures. The great thing was to give them plenty of interest outside themselves and then one had the answer. The child who was thumb-sucking presented for the moment a picture of peace and order, as a general rule, but it usually meant an escape phenomenon out of a field of boredom or some general dissatisfaction with the environment.

Mr. BERESFORD said he believed thumb-sucking could be a primary cause of dental abnormality, though it was not invariably or necessarily so.

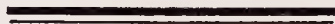
Mr. OGSTON asked whether in making the tables any notice was taken of large families. If they were included in the original investigations, did Dr. Wallis by

any chance assimilate the families themselves and their relative postnormalities to the overall picture, and was it comparable?

Dr. WALLIS said the answer was no. He had records which he could look up but he had not made any tables of them. He had merely taken the fifty cases that came along from Mr. Trevor Johnson and had turned out twins, as he had said, because he did not want them in.

Mr. TREVOR JOHNSON said there was one very important question that ought to be answered: whether it was possible for a child to develop postnormal occlusion. The nearest answer he could give was probably very rough and ready and quite inaccurate. He thought a child was born with a pattern that it would either not develop a postnormal occlusion or would develop a postnormal occlusion, or that it had a tendency that way. It could be pushed over to the postnormal side by habit or any other environmental factor. Heredity was, he thought, the dominant factor, but he did not think a child could develop postnormality unless he had a tendency in the beginning.

Dr. WALLIS said this summed up the whole thing in a nutshell.



Some Cases to Illustrate the Relationship Between Aetiology, Prognosis and Treatment Planning in Orthodontics

C. F. BALLARD, F.D.S.R.C.S., M.R.C.S., L.R.C.P. and

D. P. WALTHER, L.D.S.R.C.S., M.R.C.S., L.R.C.P.

PART I

MR. C. F. BALLARD

IN THE early days of the life of the Institute of Dental Surgery it was decided that the clinical work of the Orthodontic Department should be so recorded that it was hoped within a few years to be able to make definite statements as to what happened during treatment. An important outcome of this would be, it was hoped, a more definite knowledge of the causes of dento-alveolar malrelations and a better approach to assessment of prognosis. What I mean by prognosis is that if as the result of our studies we could, after a complete examination of each individual case, say exactly what the stable end result would be, then treatment planning would be simplified. My main object this evening is to demonstrate that the key to satisfactory treatment planning is the ability to assess where the lower labial segment will be stable in the end result. Tweed has said this, but makes the mistake of stating that stability is 'over basal bone', whereas the fundamental factor in stability is soft tissue behaviour. I must admit that in those early days I had certain preconceived ideas, but these did not interfere with the general plan, and I have had to modify them only slightly as a result of our findings to date.

Mr. Walther and I between us are going to give you very briefly, firstly, a resumé of some of our findings, and then show you some cases.

As I have said in previous papers, the main basis for a diagnosis, treatment plan and prognosis, is an adequate knowledge of—

1. The growth and development of the skeletal pattern, and the changes that might occur during treatment.
2. A knowledge of soft tissue behaviour and the relationship between the soft tissue behaviour and the dento-alveolar structures.
3. A knowledge of posture and movements of the mandible. This is with particular reference to the position of the condyles.
4. The relationship between tooth size, dental arch size, and the significance of this in overcrowding and treatment planning.

One concept that had to be proved or disproved was that the dental base relationship was an inherent property of the individual; this did not change with the growth of the individual and could not be changed by dental treatment except in those cases where there was a disturbance in posture of the mandible. This view has, on the whole, been confirmed. We have not found that the dental base relationship changes significantly during treatment with either fixed intermaxillary appliance therapy or with functional appliance therapy. Occasionally one does see cases in which there has been some significant dental base relationship change. These are probably unusual variations in the inherent growth

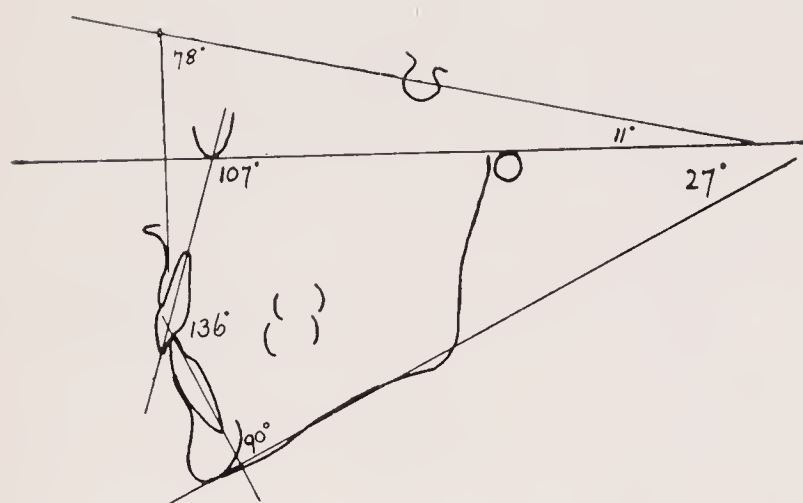
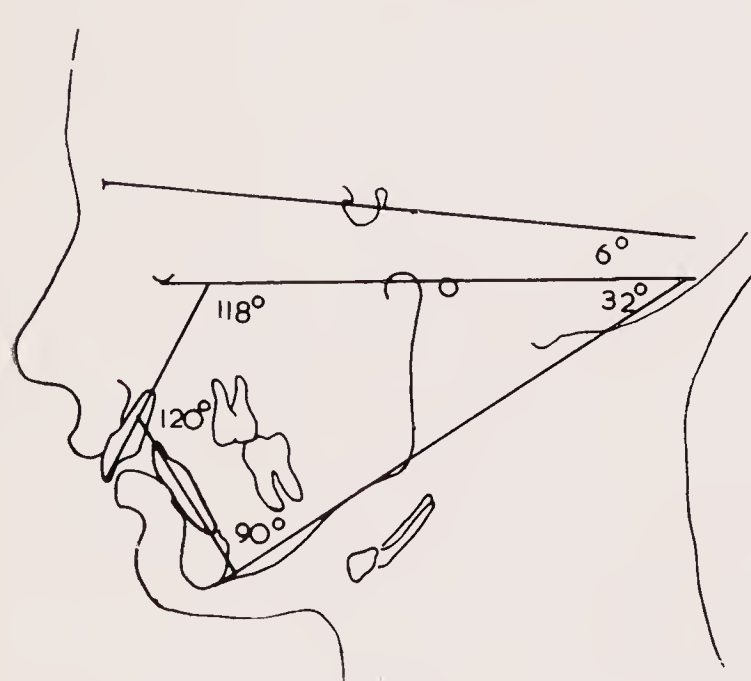


FIGURE 1

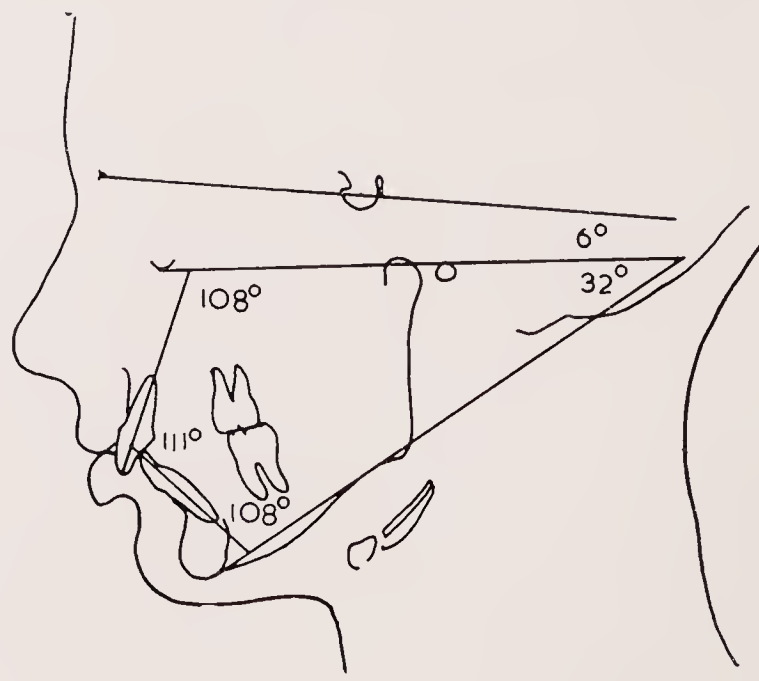
of the individual. The work of Lande recently published in the Angle Orthodontist seems to indicate that in all types of skeletal morphology there is very little dental base relationship change. His findings were that the gnathion did grow forward more than the Downs' A point, but as he indicated in his conclusions, the gnathion grows forward in relation to B point, and B point does not change its antero-posterior relationship to A point any significant amount. It may be that there are certain types of skeletal morphology in which, with or without treatment, the mandibular dental base will change its relationship to the maxillary dental base, but without further study on larger numbers of all types of cases this cannot be anticipated with our present knowledge.

The significance of dental base relationship assessment to prognosis is that we know within reasonable limits what dental base relationship is required if it is to be possible to achieve a normal incisor relationship with treatment. By normal is meant an occlusal relationship within an acceptable range. If therefore, a dental base relationship before treatment does not fall within a certain range of variation the prognosis for a good incisor relationship is relatively poorer. (Fig. 1: accepted mean for diagnostic purposes; acceptable variations around this have been discussed in previous papers). However, there is more to it than this.

As has been pointed out by many writers, the dento-alveolar structures must be regarded as being in equilibrium in soft tissue behaviour, whether this produces a normal or abnormal occlusion. It is important, therefore, to be able to decide what is the cause of the abnormal position of the dento-alveolar structures, how this may be the result of soft tissue behaviour, and how soft tissue behaviour can be altered to maintain a stable end result. For example, take a Class II, Division 1 incisor relationship on a Skeletal II pattern; a Skeletal II pattern being one in which the mandibular dental base is too far behind the maxillary dental base for a



A



B

FIGURE 2

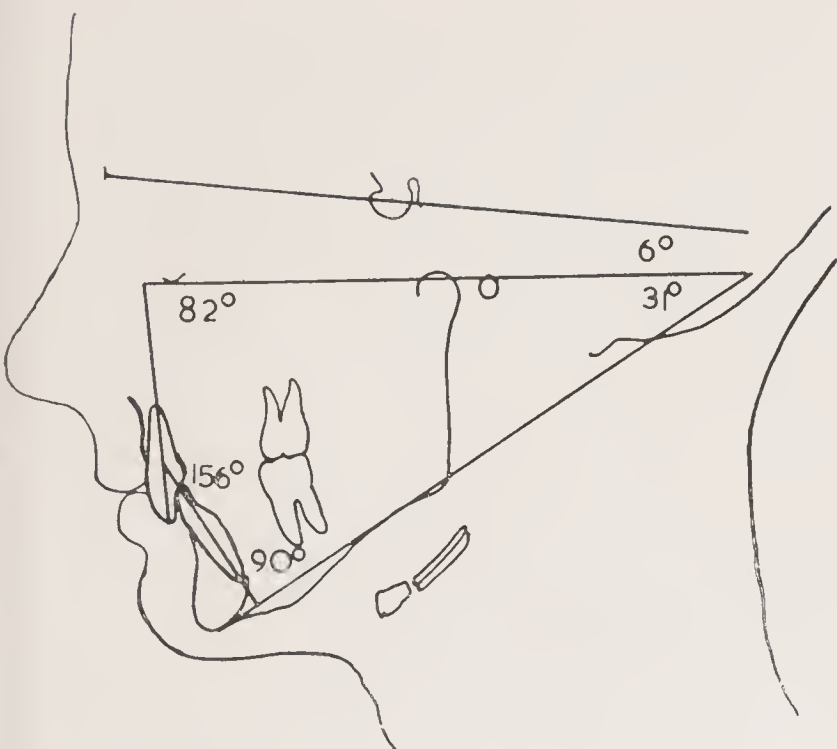


FIGURE 2C

normal incisor relationship to be achieved. (Fig. 2A). The overjet in such a case is most satisfactorily reduced mainly by a proclination of the lower labial segment and only a slight retroclination of the upper labial segment (Fig. 2B). However, as we have found, the posture and behaviour of the lower lip frequently does not permit a sufficient proclination of the lower labial segment for an optimum incisor relationship on the Skeletal II pattern (Fig. 2C). If this was not appreciated before treatment, then frequently what happens is that the whole mandibular arch is brought forward, the lower lip subsequently pushes the labial segment back, but the buccal segments do not go back and there is a resultant imbrication of the lower incisors. I have even known $\overline{4/4}$ to be pushed out of the arch as the result of lower lip action after such an incorrectly planned treatment.

Therefore, if we can say before treatment is commenced what will be the stable position of the lower labial segment, the prognosis and treatment planning is simplified. Anchorages can be balanced in such a way that the labial segments are only moved into what is thought to be the stable position, and the buccal segments are likewise adjusted to maintain a proper relationship to the labial segments.

It is our experience that many Skeletal II patterns can never be treated for an optimum incisor relationship for the dental base relationship because of the soft tissue behaviour. There is no time to go into the many variations of soft tissue, both in resting posture and movement, and I should like to confine the remainder of my short paper to the two important variations, i.e. incompetent lips, and the abnormal swallow, with particular reference to the Skeletal II morphology.

The incompetent lip action is when, with the mandible in the physiological resting position and the muscles of the face in physiological rest, the lips do not meet. (Fig. 3). In this type of case the individual can never close the lips without contraction of the mentalis and orbicularis oris in particular, and that applies throughout their life. There cannot be a change in the inherent morphology of the individual. Many individuals are incompetent but overcome the lips-apart posture by contraction of the musculature very early in life. I am not certain in my own mind that incompetence on its own is associated with an abnormality of labial segment position when the dental base relationship is within the normal. However, when the dental base relationship is Class II the contraction of the lower lip both to close the lips and during swallowing, particularly the contraction of the mentalis and orbicularis oris in the lower lip, maintains the lower labial segment in a relatively retroclinated position which produces the typical Class II, Division 1 incisor relationship. In such cases we are now certain that the lower lip is a limiting factor in the degree to which the lower labial segment can be proclinated to overcome the Skeletal II pattern. The greater the incompetence, the less the lower labial segment can be proclinated. It may be that when we have treated several hundred cases with an accurate cephalometric analysis of the stable end result, we shall be able to say when the incompetent



FIGURE 3

lips are apart about half an inch the lower labial segment must not be proclinated at all. However, that is looking too far ahead.

I am now going to show you the tracings of a case which illustrates my point (Fig. 4). The boy was originally referred from an ear, nose and throat clinic as an adenoidal type, which he certainly is not. He is a true incompetent lip action and not a mouth-breather (see previous papers, Ballard and Gwynne-Evans). He was put on to Class II traction without any decision as to whether the labial segments would be stable in a more proclinated position. The Class II traction pulled forward his mandi-

bular dentition more than it took the maxillary dentition back. This produced a fairly satisfactory incisor relationship. However, because the orbicularis oris and mentalis always contracted when he closed his lips the lower labial segment was pushed back almost to its original position, and he had to be retreated. The stable position of the lower labial segment is only 4° proclinated from the original position. His upper incisors now look aesthetically satisfactory, but that is only because they have not been taken right back to his lower labial segment. If they were, they would look most unsatisfactory.

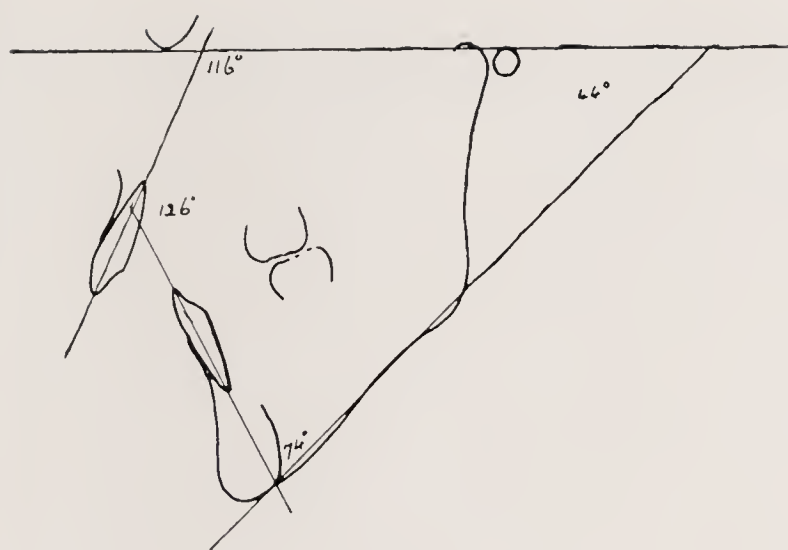


FIGURE 4A

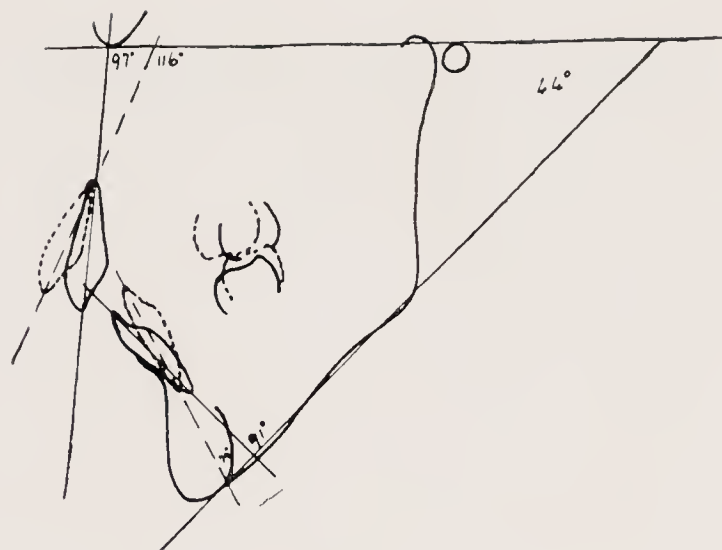


FIGURE 4B

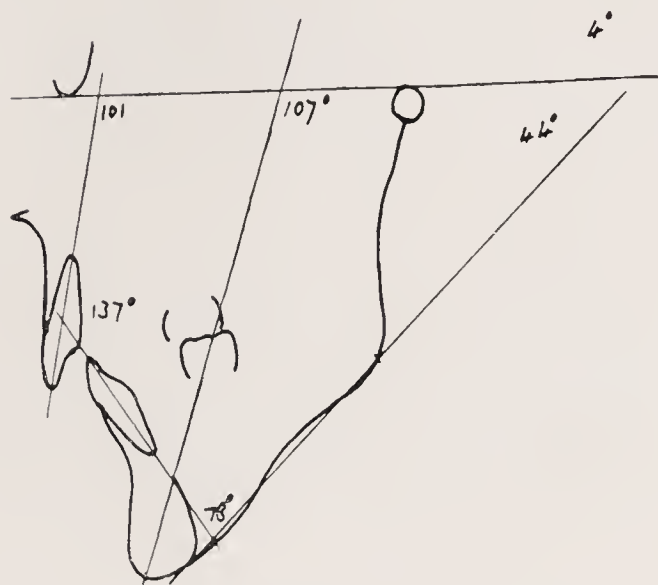


FIGURE 4C

He is so incompetent that he cannot even by conscious effort maintain the lips closed posture. If he could maintain the lips closed posture, then the present position of his upper incisors would not be stable. They would have to be lingually inclined against his lower incisors.

The next broad group of cases are those in which there is a Skeletal II pattern but only an insignificant or no incompetence of lip action. (Fig. 5.) In these cases the lower lip, attached to the mandibular basal bone, is in its resting position behind the developing upper labial segment, and this seems to be the obvious explanation of the typical Class II, Division 1 incisor relationship on such a skeletal pattern, the upper labial segment developing between the lips and anterior to the lower lip. The lower lip in these cases is usually full and

everted, and but for the position of the upper incisors between the lips one could imagine them meeting without contraction of the musculature. In such cases we have found that the lower labial segment can be proclinated many degrees to help overcome the Skeletal II dental base relationship. This produces a much more satisfactory end result than does the previous group of cases that I described. Treatment is planned to bring forward the whole mandibular arch and anchorage is balanced so that the maxillary arch only goes distally a sufficient amount to meet what has been calculated to be the stable position of the lower arch, in particular, the lower labial segment.

Now for the abnormal swallowing behaviour (Rix). The abnormal swallowing action will produce anything from an anterior open bite to a typical Class II, Division 1 incisor relationship, and I believe that the degree of overjet and/or overbite is to a great extent determined by the dental base relationship. On a normal dental base relationship the tongue thrust tends to maintain with competent lip action an anterior open bite, whereas on a Skeletal II dental base relationship the abnormal swallow tends to produce more overjet than open bite or reduced overbite.

It is not so easy to make any definite statements about the assessment of prognosis in cases of abnormal swallowing. In mild degrees of abnormal swallow it is



FIGURE 5A



FIGURE 5B

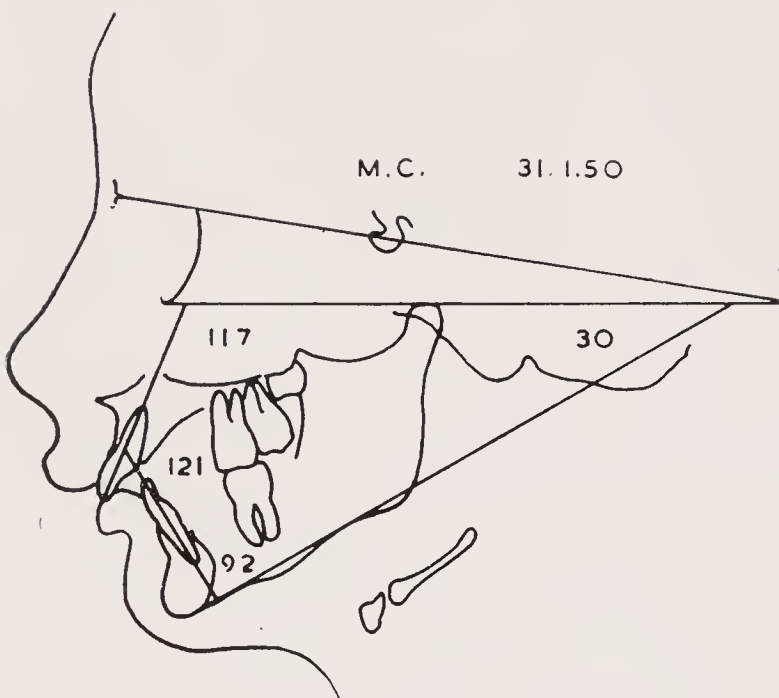


FIGURE 5C

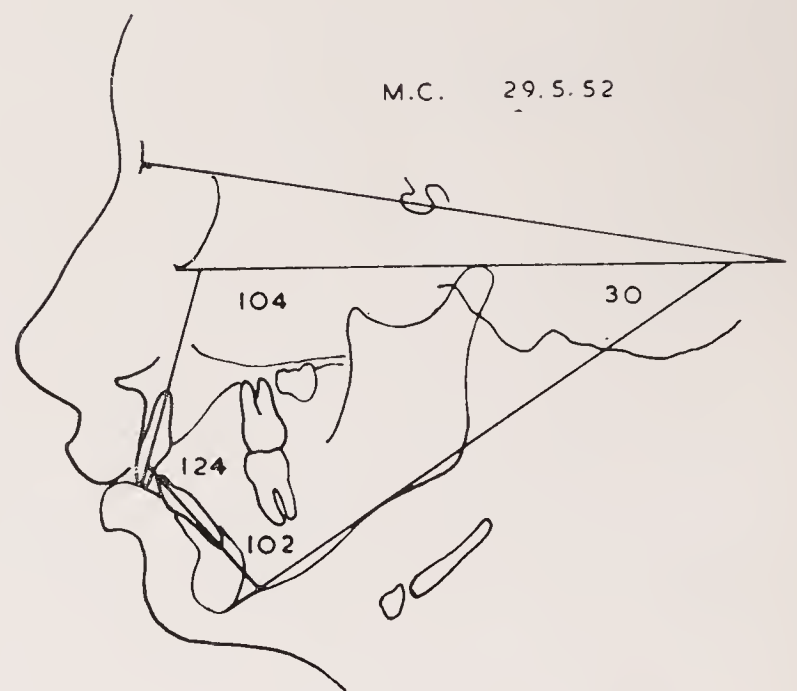


FIGURE 5D

possible that as a result of treatment the tongue thrust is completely eliminated. On the other hand, we know that in many cases it is never completely eliminated. Our experience is that when the abnormal swallow is associated with a Skeletal II pattern one plans one's treatment in all cases as though it were going to be eliminated and as though the mandibular dentition can be brought forward against the contraction of the lower lip, which resists the tongue thrust during swallowing. As

one closes up the overjet, a degree of open bite tends to develop if the tongue thrust is uncontrollable. In the majority of cases, however, the relapse is not complete; the patient no longer has a proclinated maxillary labial segment, but they have some reduction of overbite with the tip of the tongue resting between the teeth and thrusting during swallowing. The prognosis in these cases is far worse if, associated with the Skeletal II pattern and the abnormal swallow, there is a true

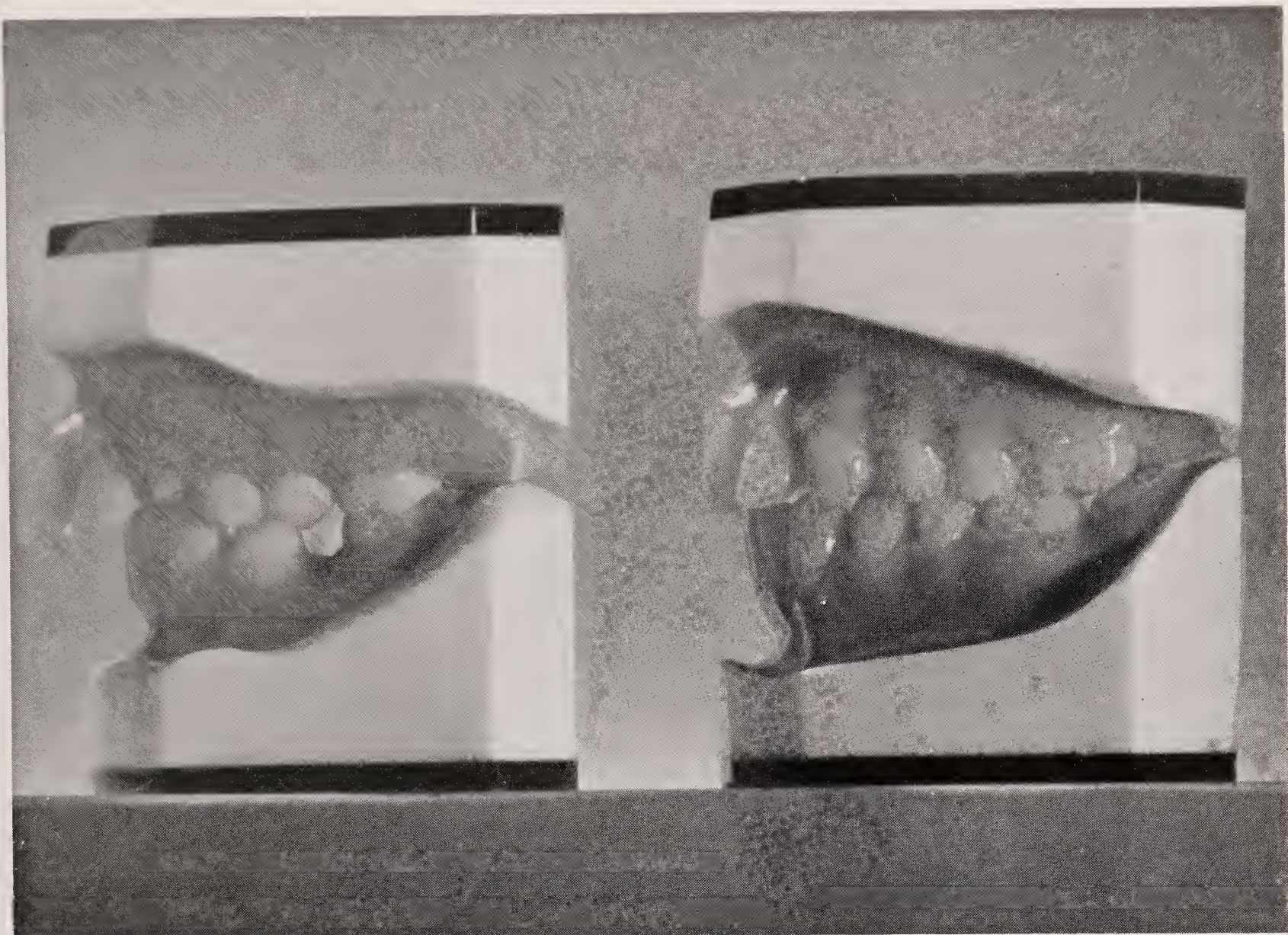


FIGURE 5E

incompetence of lip action.

It may be that before we are more certain of our prognosis in the abnormal swallowing cases we shall have to break them down into various groups. For instance, I believe that there are two broad types of abnormal swallow, one having a definite poor prognosis. Broadly speaking, they are, first, that in which the tip of the tongue is formed during swallowing and thrust forward over the lower labial segment against the upper labial segment and against the contraction of the lower lip; secondly, that in which the anterior border of the tongue is not firm at all, but is thrust through as a loose, flabby mass. It is a very common finding in these cases that there is associated with this type of abnormal swallow an interdental sigmatism. The interdental sigmatism is such that the speech therapist has great difficulty

in eliminating it. This latter group of cases show very poor prognosis for much improvement of labial segment relationship, particularly when there is an open bite.

Finally, I must mention the habits of finger and thumb-sucking. I believe that finger and thumb-sucking are of no great importance in the production of abnormal incisor relationship, and that when there is a marked abnormality of labial segment relationship associated with the habit, then invariably an underlying cause is one of the factors already mentioned, i.e. incompetent lip action, an abnormal swallow, or Skeletal II pattern. For this reason, control of the habit does not result in any important improvement in labial segment relationship without the extensive treatment necessary as indicated by the underlying factors.

PART II

MR. D. P. WALTHER

THE FOLLOWING cases will illustrate the use of lateral X-rays of the skull as a diagnostic aid. Diagnoses and treatment can of course be made without use of lateral X-rays, but X-rays not only give additional information, but by them measurements obtainable by other means are more easily made. Information is also gained by super-imposition of serial X-rays or tracings, the only danger being that false deductions might be made from this procedure if the limitations of the process are not realised.

The face and skull develop as a whole, bone apposition occurring at the sutures and upon various bone surfaces. By super-imposition of X-rays the exact site of bone apposition cannot be determined, moreover registration points and planes are themselves altering with growth. The correct registration point for the study of facial development is itself still a matter for debate.

The best that can be done is to take a point somewhere in what appears to be a centre of the growth of the area under investigation, super-impose the X-rays on this point, and orientate them to a definite plane, realising that both point and plane are subject to alteration. The registration point that I have taken is the one used by Broadbent, which is the centre of a line perpendicular to the Bolton nasion plane to the centre of the sella turcica.

Recently some workers have been using nasion and the nasion to sella plane on which to super-impose these X-rays. I have therefore included some tracings orientated in this way and to demonstrate the different picture obtained.

A further difficulty is that of obtaining true lateral X-rays as the repositioning of the subject is not as easy as is usually described. The ear plugs on the apparatus

may be rigid and the machine mechanically sound, but the child is still able to move upon the ear plugs to a certain extent, and pictures differ slightly. This error must be taken into account.

For the diagnosis and treatment planning of a case: models are taken, X-rays of the teeth, lateral X-rays of the skull and a full clinical examination, with particular attention to muscle and skeletal patterning which Mr. Ballard has described.

CASE 1 is a girl aged $10\frac{1}{4}$ with a Class II, Division 1 occlusion. The lateral skull X-ray, however, shows her to have a Skeletal I dental base relationship. There is a marked proclination of the upper incisors with mesial inclination of $3/3$ and a forward position of the buccal segments maintaining intact contact relationship. $6/$ is in buccal occlusion to $\bar{6}/$, and there is antero-posterior crowding in the mandible as indicated by $\bar{3}/$ overlapping $\bar{2}/$ and impaction of $/5$. She had an abnormal swallow and incompetent lip action.

Fig. 1A shows a tracing of a lateral skull X-ray. The skeletal pattern is Class I (which means that the dental bases of the upper and lower incisor regions are within normal antero-posterior relationship). The upper incisors are proclinated 128° to the Frankfort plane. The lower incisors are 90° to the mandibular plane. The Frankfort mandibular plane angle is 26° . The angle between the upper and lower incisors is 116° , which is on the low side.

$\frac{4}{4}/\frac{4}{4}$ were extracted. The buccal occlusion of $6/$ was corrected, the upper incisors

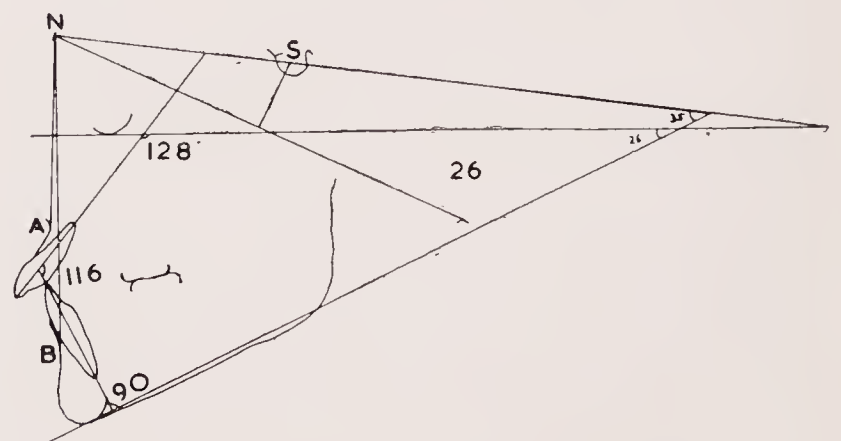


FIGURE 1A



FIGURE 1B

retracted, and $\overline{65/56}$ brought forward with intermaxillary traction.

Fig. 1B shows original models above. The middle set of models shows her condition one year after treatment. Note the improvement, but $\overline{7/}$ has now erupted in buccal occlusion. Below are the models after one year and three months' treatment, in which this has been corrected.

Fig. 1C shows tracing of lateral skull X-rays taken nine months after commencement of treatment.

Fig. 1D shows the two skull tracings super-imposed on the registration point. *Fig. 1E* shows the tracings super-imposed on nasion.

The particular interest of this case is that the postnormal occlusion of the teeth was upon a Class I skeletal pattern which even tended to Class III and in consequence it was decided to extract $\overline{4/4}$ as well as $\overline{4/4}$ with the result you see.

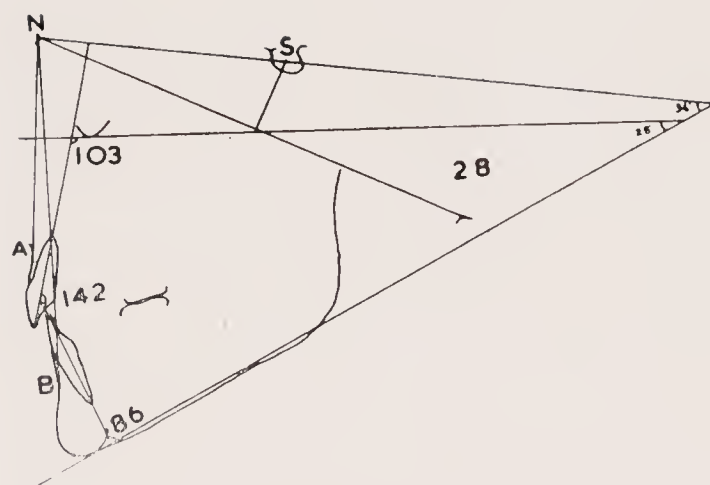


FIGURE 1C

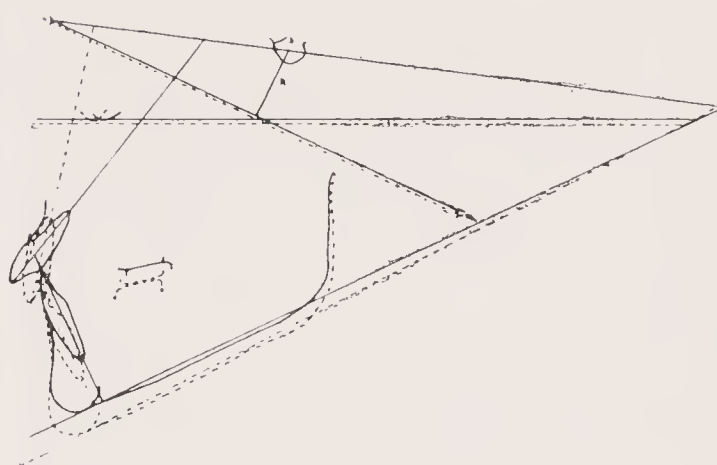


FIGURE 1D

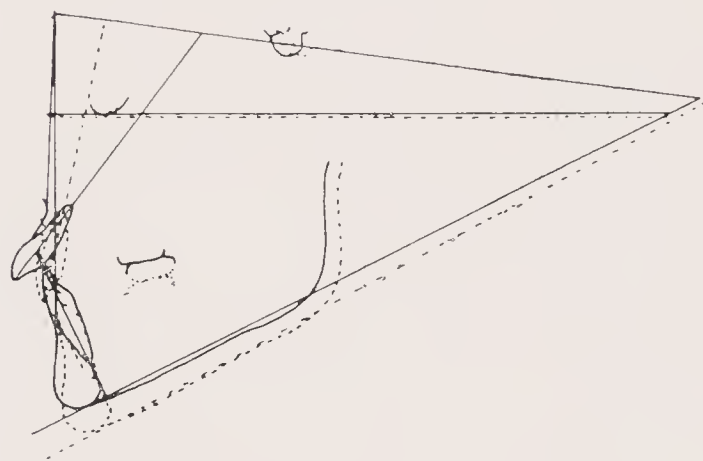


FIGURE 1E

If these teeth had not been extracted, then the treatment to correct the antero-posterior crowding would have resulted in some proclination of $\overline{21/12}$. This would have prevented full retraction of $\overline{21/12}$. In other words she would have finished as a bimaxillary protrusion and the lip incompetence would as a result have been worsened.

CASE 2 is a boy aged $13\frac{1}{2}$ years with an extreme Class II, Division 1 occlusion. This has been complicated by early loss

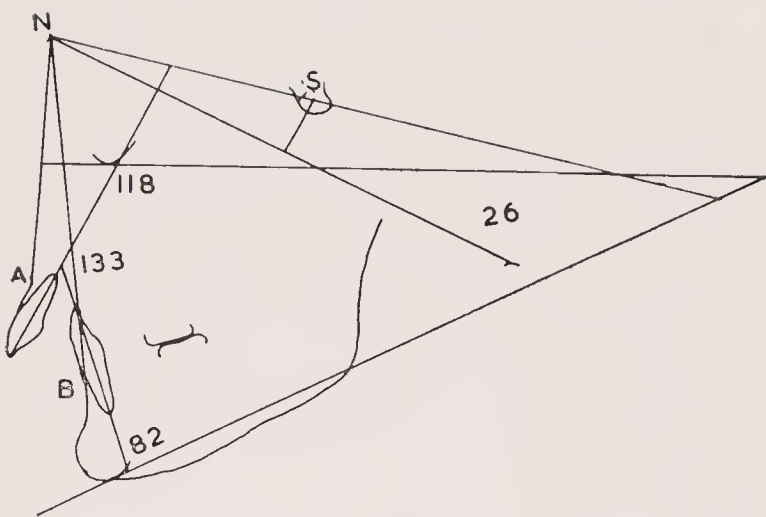


FIGURE 2A



FIGURE 2B



FIGURE 2C

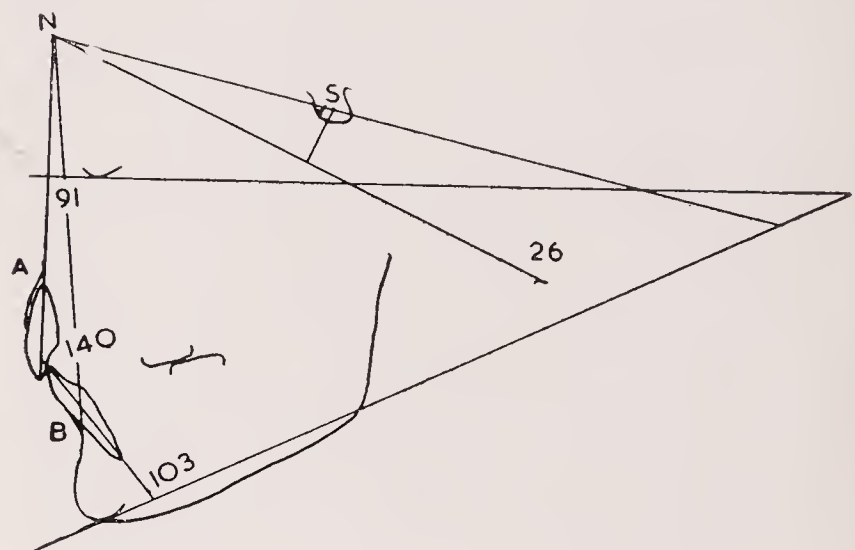


FIGURE 2D

of temporary molars, collapse of the lower arch and $\overline{5/5}$ are impacted. His lips could not be approximated owing to the excessive protrusion of his upper incisors. *Fig. 2A* shows tracing of the lateral X-ray. The skeletal pattern is Class II. The upper incisors are proclinated to 118° to the Frankfort plane (which is not so severe as the first case, but the overjet is worse

because of the skeletal pattern and the relative retroclination of the lower incisors which are 82° to the mandibular plane). The Frankfort mandibular plane is 26° .

$\overline{4/4}$ were extracted. The upper incisors and canines were retracted and the lower incisors were proclinated and depressed and space was opened up for $\overline{5/5}$. Intermaxillary traction was carried out for nine months.

Fig. 2B shows some of the appliances used—an upper free-sliding labial bow and a lower buccal arch as in the first case, with intermaxillary traction elastics.

Fig. 2C shows original models and those after one year and two months' treatment. *Fig. 2D* shows tracings of lateral X-rays after one year of treatment. The upper incisors are retroclinated to 91° to the Frankfort plane and the lower incisors proclinated to 103° to the mandibular plane.

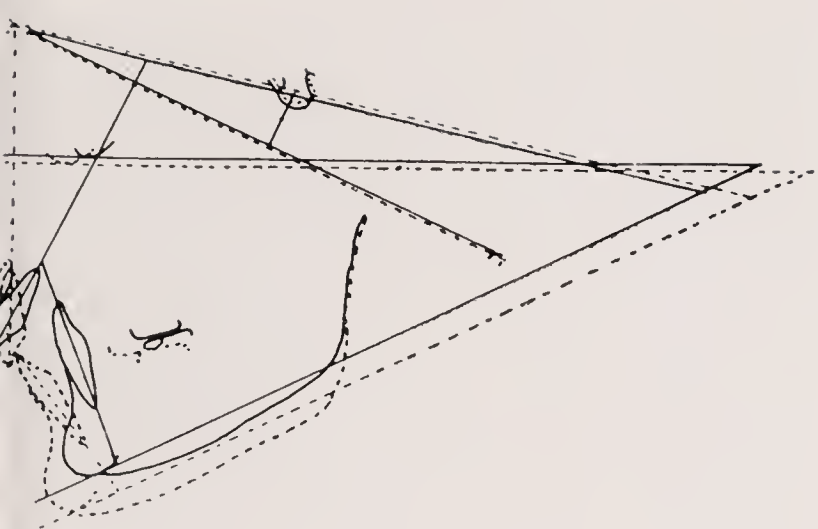


FIGURE 2E

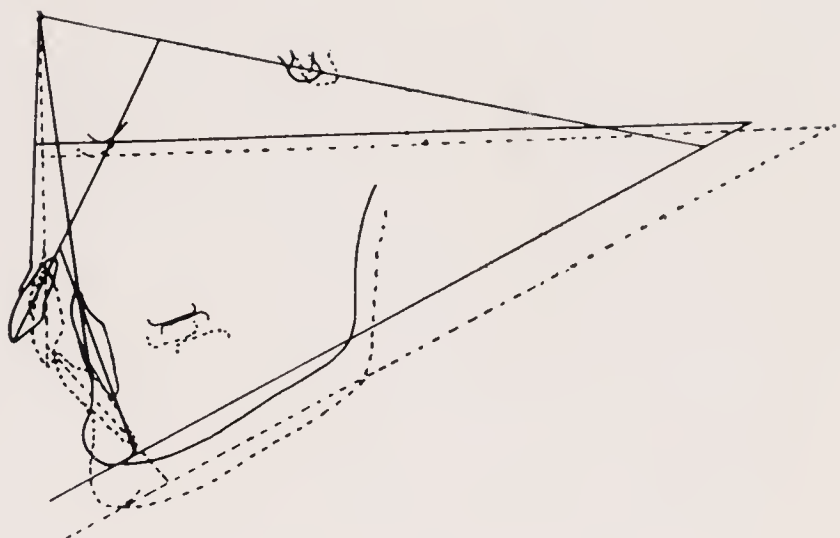


FIGURE 2F



FIGURE 2G

Fig. 2E shows tracing super-imposed on the registration point. What is interesting is that the relative forward position of the chin represents the degree of anteroposterior growth of mandible during treatment period, but if tracings are super-imposed on nasion, (*Fig. 2F*) there appears to be no significant change of dental base relationship resulting from this growth.

Fig. 2G shows the photograph before and after treatment. The particular interest of this case is the extreme Skeletal II pattern, but with potentially good lip musculature.

It was very important in this case to judge from a study of the lip posture and action that the lower labial segment could be proclinated so much with a reasonable

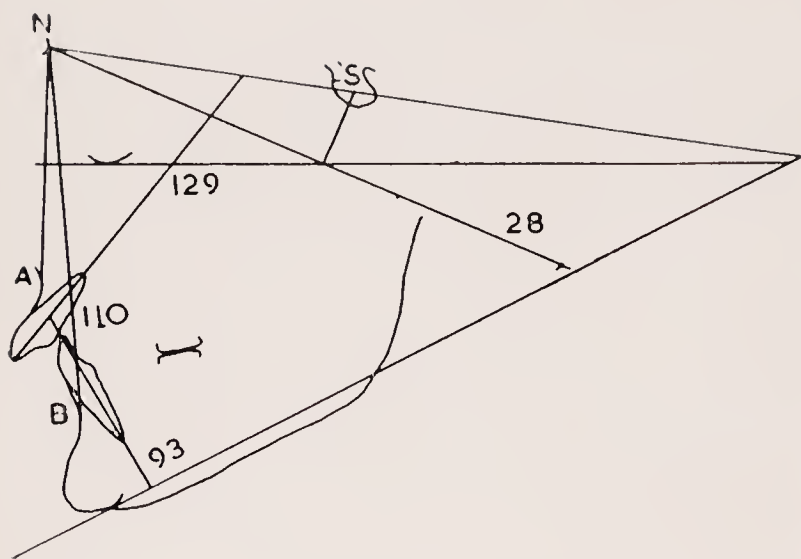


FIGURE 3A

chance of its remaining stable. The upper labial segment is retroclinated even now, but what an aesthetically unsatisfactory result it would have been if it had had to be retracted still further because lip action would not permit proclination of the lower labial segment.

CASE 3 is a girl aged 11 years. She has a Class II, Division 1 occlusion. The lateral X-ray shows a mild Skeletal II base, but the lower incisors are proclinated, compensating for this (see Fig. 1, Ballard). There has been early loss on the right side resulting in a forward movement of $\bar{6}/$ which is therefore in pseudo-normal occlusion with $\bar{6}/$ with crowding of $\bar{54}/$. The lower centre line is slightly to the left. The anterior oral musculature was incompetent and she had an abnormal swallowing behaviour.

Fig. 3A is a tracing of the lateral skull X-ray taken before treatment. The upper incisors are very proclined at 129° to the Frankfort plane. The lower incisors are slightly proclined at 93° to the mandibular plane. The Frankfort mandibular plane angle is within normal limits at 28° . The $\bar{4}/\bar{4}$ were extracted—the upper incisors and canines were retracted, and the lower arch reconstituted; the $\bar{6}/$ being uprighted and the lower incisors were further proclinated.

Fig. 3B shows original models above. The middle set of models shows her



FIGURE 3B

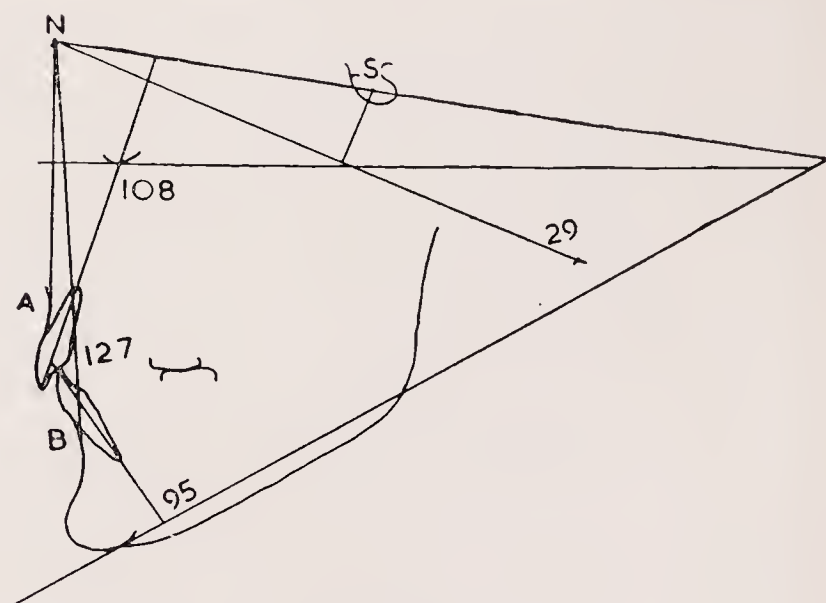


FIGURE 3C

condition two years after the start of treatment, and final models $2\frac{1}{2}$ years after. Enough space was obtained in the lower arch for all the premolars.

Fig. 3C is a tracing of the lateral skull X-rays taken two years after the treatment

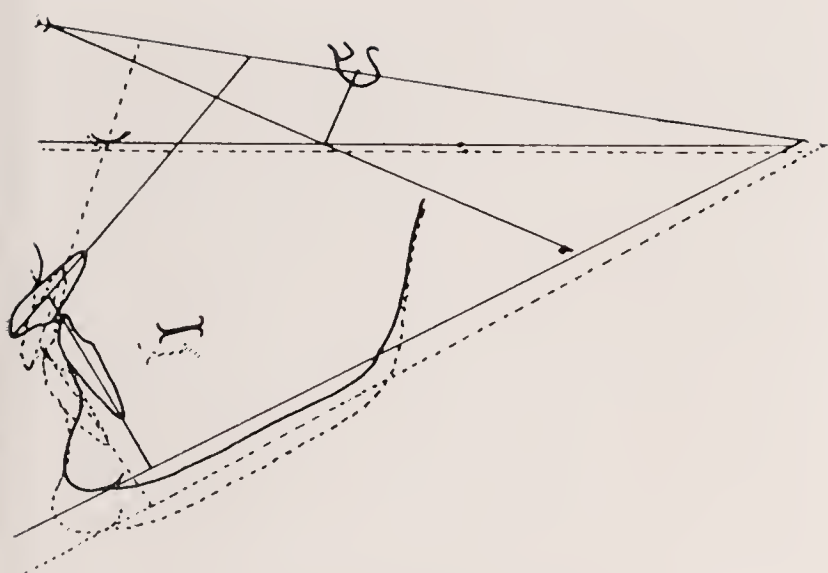


FIGURE 3D

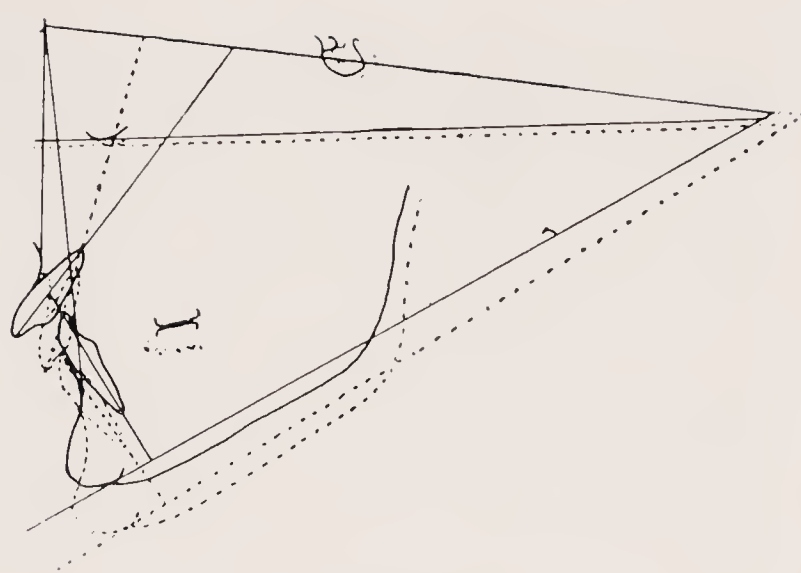


FIGURE 3E

began. The upper incisors have moved back to 108° to the Frankfort plane and the lower incisors are now at 95° to the mandibular plane.

Fig. 3D shows before and after tracings superimposed on registration point.

Fig. 3E shows before and after tracings superimposed on nasion. Her anterior oral musculature is now competent but she still has an abnormal swallow. The interest of this case is that we risked overproclinating the lower incisors to accommodate the instanding $\bar{5}$, possibly placing them outside the area of muscle balance. Intermaxillary traction is contra-indicated in such a case as the lower segments would

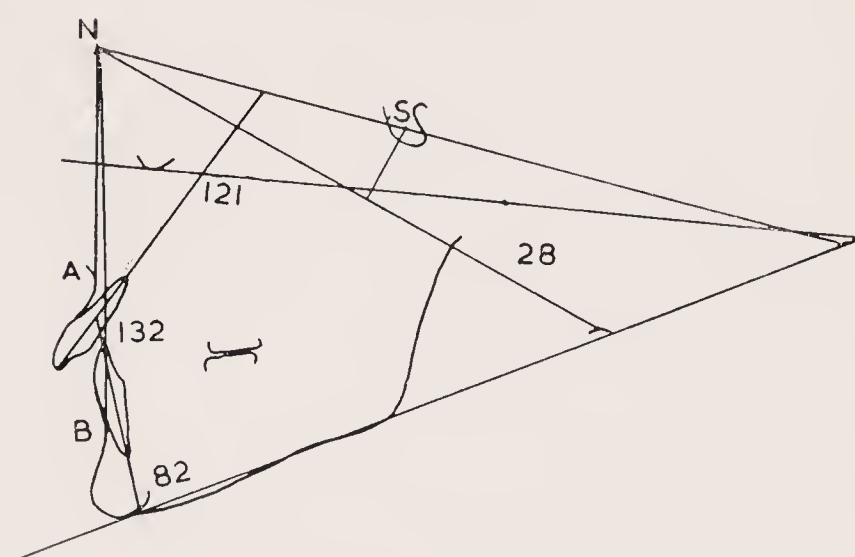


FIGURE 4A

inevitably move forward and cause overproclination followed by collapse and imbrication of the lower incisors.



FIGURE 4B

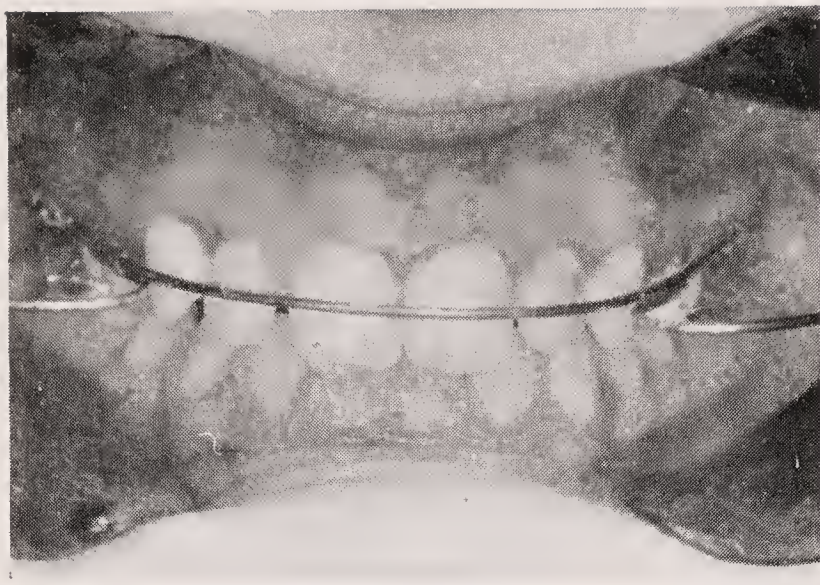


FIGURE 4C

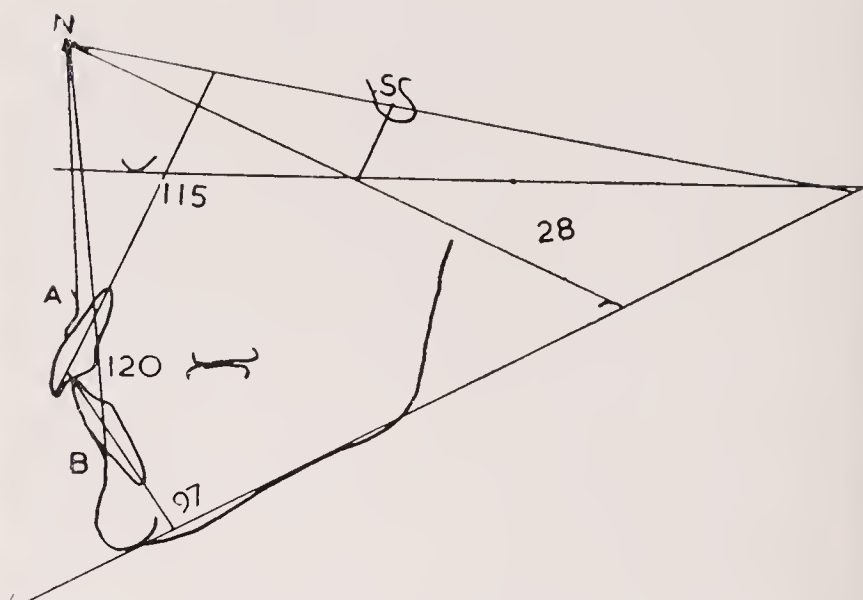


FIGURE 4D

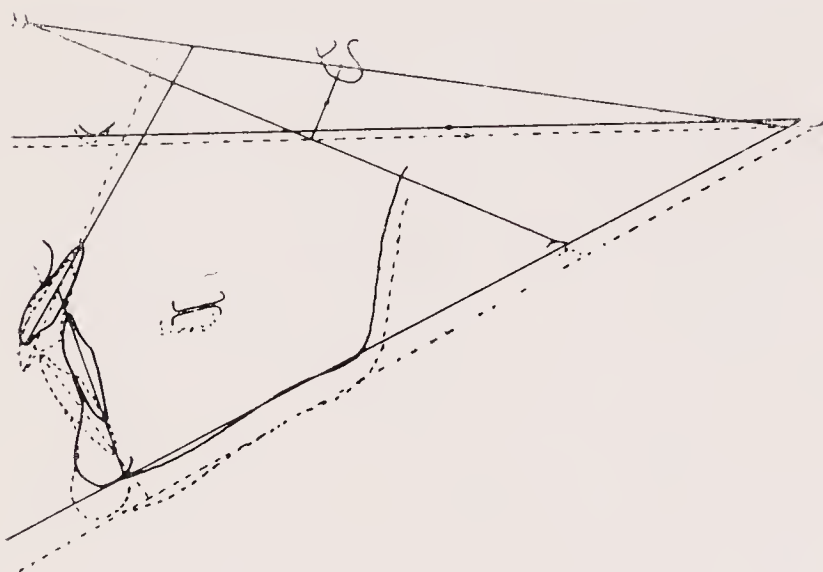


FIGURE 4E

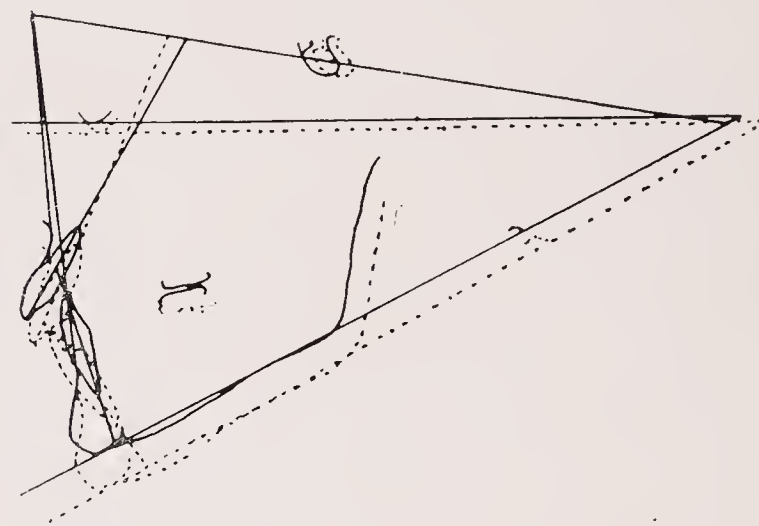


FIGURE 4F

CASE 4 is the younger sister of Case 3. She also has a Class II, Division 1 occlusion, but on a Skeletal I dental base relationship. There has been a collapse of the lower arch due to early loss of temporary teeth which has resulted in the lower incisors being retroclined and the lower molars tilting mesially. There is excessive overbite and overjet. Her anterior oral musculature was incompetent and she had an abnormal swallow.

Fig. 4A is a tracing of the lateral skull X-rays before treatment. The upper incisors are proclined to 121° to the Frankfort plane, whilst the lower incisors are retroclined to 82° to the mandibular plane. The Frankfort mandibular plane angle is 28° .

The lower arch was reconstituted by uprighting the molars and proclination of the lower incisors. The remaining overjet was corrected by using occipital traction

at night reinforced with very light inter-maxillary traction during the day to start with, but discontinued after two months for fear of over-proclinating the lower incisors.

Fig. 4B shows the night appliances in use. *Fig. 4C* shows the intra-oral part of the appliance.

Fig. 4D shows a tracing of the lateral skull X-ray taken $2\frac{1}{2}$ years after treatment. The upper incisors are back to 115° to the Frankfort plane and the lower incisors have been proclined to 97° to the mandibular plane.

Fig. 4E shows the super-imposed tracing of the lateral skull X-ray on registration point.

Fig. 4F shows the superimposed tracing of the lateral skull X-ray on nasion. In spite of the rather extreme proclination of the lower incisors created by treatment in order to make room for the lower pre-

molars, she will probably be stable. Theoretically she is now a bimaxillary protrusion, and should have lost a unit in all segments.

These cases demonstrate our approach to the diagnosis and treatment planning and the assessment of what has taken place during treatment and growth. The appliances are not shown to demonstrate the method of treatment so much as the carrying out of a treatment plan suggested by diagnosis and prognosis.

Although one uses diagnostic aids such as models and X-rays the assessment of a case is upon clinical examination. Prognosis depends upon posture of lips and tongue and a study of their movements and upon the general attitude and poise of the patient, all of which can be assessed only by clinical means.

We wish to acknowledge the help of Mr. D. R. MacDougall, the Photographer at the Eastman Dental Hospital, in producing the illustrations.

Owing to lack of space, one case in Part II has been omitted.

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DISCUSSION

Mr. J. D. HOOPER, in opening the discussion, said:

Mr. PRESIDENT, Ladies and Gentlemen, it is a great pleasure to me to have the honour of opening the discussion on this paper. Like all Mr. Ballard's contributions to this Society it is a paper full of original thought and stimulating ideas. Both Mr. Ballard and Mr. Walther are to be congratulated on the clarity with which they have demonstrated these ideas and presented the cases. I think, also, that each was fortunate in having the other to perform their complementary roles.

Cephalometric analysis of cases under treatment is a thing we have long been hoping to see in this country. In the early days of my association with Mr. Ballard—when many of the germs of his ideas were, so to speak, incubating—a cephalometer was a thing we dreamed of having in order to test the truth or falseness of these concepts. And now, seven years later we see the first set of cases treated under cephalometric control.

There has been a tendency in this country to cry down the findings of cephalometric radiography. I would like to say at once that I deplore this tendency. When all the obvious things have been stated regarding human error, tracing difficulties, radiographic distortion and so on, cephalometric radiography remains far and away the most accurate means at our disposal for finding out what happens during treatment. I suppose there is only one other way in which more accuracy could be obtained and that would be by dissecting the specimen at the end of the experiment. In spite of these severe provocations, to which we are sometimes subjected, few of us would care to go to this length. As far as I can see cephalometric radiography offers the best hope so far of accurate assessment of results and I only wish that the necessary apparatus were not so prohibitively expensive.

Having said this I do not think that lateral radiography alone is sufficient for accurate prognosis although this tendency is noticeable in some American publications. This paper rightly emphasises the necessity of relating muscle pattern to skeletal pattern and this to my mind is what matters.

We are dealing here very largely with the treatment of Angle's Class II, Division 1, and I would say that in the successful treatment of this condition it is the assessment of the muscle pattern which is the more important if a stable result is to be obtained.

Mr. Ballard shows two cases both assessed as skeletal Class II. In one case the lower labial segment could be proclined in order to reduce the overjet and remain stable in that position—in the other it could not. Now, the diagnosis of skeletal pattern rests on the arbitrary assumption that the normal axial inclination of upper and lower incisors is 105 degrees to the Frankfort and 90 degrees to the mandibular planes. This assumption holds good for the majority of children in this country but I believe that it should be modified if there is reason to believe that a different racial stock is involved. I noticed that the name of the first child was Chrysler and this suggests to me a continental origin. In such a case I am not surprised that the lower incisors remain stable in a relatively proclined position as this may well be the normal for this type. The second case which had to be retreated I know of old as a typical product of a combination of all the worst dento-facial features of the inhabitants of these islands and is a totally different type from the other one. It seems to me that for two such different patients to fall into the same skeletal category reveals a fault in the classification. I would like Mr. Ballard's comments on this point.

All the cases shown to-night have been of the Angle's Class II type. I think it should be pointed out that skeletal

analysis is also helpful in Class I cases. There is a definite type of patient which, if no teeth have been prematurely lost, shows the following features:

The molar is Class I.

The upper incisors are imbricated.

And the lower incisors are retroclined and imbricated.

Almost invariably this type will be found to have a Class III skeletal pattern and the symptoms seem to me to follow from this. The upper incisors are crowded because the upper apical base is small both in relation to the lower and to the size of the teeth. The lower incisors are crowded because the skeletal pattern dictates a retroclined position and this in turn reduces the size of the dental arch. The point is that if this analysis is correct extraction in both arches is the only way of relieving the imbrication and this in my experience is born out by the results. I usually treat such cases by the extraction of four deciduous canines if the case is seen early followed by the extraction of four first premolars later. In most cases spontaneous improvement of the condition follows and no appliances are necessary. I would ask Mr. Ballard whether he supports this view.

Finally I would like to ask Mr. Ballard and Mr. Walther whether they have yet been able by lateral radiography to ascertain with certainty what degree of so-called collapse takes place, particularly in the lower arch, after premature extraction of deciduous molars. It seems to me that if this could be found out it would be of great assistance in planning treatment in cases where early loss has occurred.

Thank you Mr. Ballard and Mr. Walther for a most stimulating and instructive paper.

Mr. K. WONGTSCHOWSKI said that he was very interested in the subject of the papers, which was one to which he had devoted much thought during the last few years. He was grateful to Mr. Ballard for letting him see his paper before the meeting, and to the President for allowing him

to take part in the discussion.

In his paper Mr. BALLARD said: "One of my beliefs was that the dental base relationship was an inherent property of the individual, etc." It seemed to him that the aim of orthodontic treatment should be a change in the dental base relationship, and he would be glad if Mr. Ballard would enlighten him on that point.

He agreed with Mr. Ballard's statement that an orthodontist could not be too careful in trying to move the lower labial segment forward, and he appreciated the restrictions which Mr. Ballard had imposed on himself concerning that movement. In his opinion, the movement of the lower segment often resulted not in a relapse caused by increased lower lip pressure but in a relapse caused by the natural elasticity of the alveolar process, which tried to return to its former position.

He would like to ask whether in many cases, after proper orthodontic treatment, the habit of abnormal swallowing would not disappear.

He did not think that finger and thumb-sucking were of no great importance in the production of abnormal incisor relationships. He regarded the fingers and thumbs as possessing the same power as orthodontic appliances and he thought that they must have an influence upon the tissues.

In referring to his second case, Mr. Walther said: "What is interesting is that the relative forward position of the chin represents the degree of antero-posterior growth of the mandible during the treatment period, but if tracings are superimposed on Nasion there is no significant change of dental base relationship resulting from this growth." He would be glad if Mr. Walther would explain that point to him.

At the end of his paper Mr. Walther said: "I must point out that, although one uses diagnostic aids such as models and X-rays, the assessment of a case is done by clinical examination." That, of course, was the right method to adopt in orthodontic

cases, and, furthermore, what Mr. Ballard and Mr. Walther had done.

Mr. K. E. PRINGLE asked whether Mr. Walther found Nasion a suitable point from which to make his registrations.

Mr. J. W. SOFTLEY said he would like to thank Mr. Ballard and Mr. Walther for their very interesting papers.

He thought that Mr. Ballard was right in placing emphasis on the lower labial segment, but Mr. Ballard had not mentioned one of the most important factors in the stability of the lower incisors, namely, the continuity of the lower arch.

He had noticed that in the one case in which Mr. Walther had removed the two lower 4's the lower incisors had inclined lingually, and he wondered whether that was not a very common experience when lower premolars were extracted. Would Mr. Ballard extract lower premolars in cases in which he wanted to procline the lower incisors?

He had noticed in Mr. Ballard's illustrations that in the cases in which he said that there was a lip incompetence the Frankfort mandibular angle was on the high side, being 39° in one case and 44° in the other, whereas in the cases in which the lips were said to be competent the Frankfort mandibular angles were as low as 31° . He wondered whether that was a common finding. Where there was lip incompetence was there usually a steep Frankfort mandibular angle or was that just a coincidence in the particular cases which Mr. Ballard had shown?

Mr. R. V. TAIT congratulated Mr. Ballard and Mr. Walther on their brilliant papers and said that there was one point on which he would like to have a little more information. They had stressed the importance of assessing the type of swallowing action, and he thought it was very difficult to do that clinically. Would they say how they set about doing it and whether they thought that their technique was satisfactory?

Mr. J. S. BERESFORD also congratulated

the authors on their papers.

He would like to know whether Mr. Walther could throw any light on the overbite problem. In his fourth case Mr. Walther had increased the inclination of the lower incisors to the mandibular plane from 93° before treatment to 95° after treatment, which did not seem to be a very great increase, yet the models and the lateral x-rays showed that the overbite had in fact been reduced. In the last case shown by Mr. Walther the increase was from 82° to 97° , and he could appreciate that that would reduce the overbite considerably. In the first case, in which four premolars had been extracted, he thought that the overbite had been greatly reduced, but it did not appear that that reduction of overbite had been brought about by a proclination of the lower incisors. He realised that if the lower incisors were tipped labially the overbite would be reduced, but it appeared that in some of his cases Mr. Walther had not done that very much and yet the overbite had been reduced. He would be grateful if Mr. Walther would comment on that point.

Mr. W. J. TULLEY said he would like to congratulate Mr. Ballard and Mr. Walther on their papers.

With regard to the lateral radiographs, he found it a little confusing that some of the tracings had been done in the rest position and some in the occlusal position. In those cases in which there was an atypical swallowing behaviour, did the authors find that in the occlusal position they sometimes got actual incisor contact?

Mr. J. H. GARDINER said that he greatly appreciated the authors' very inspiring papers.

He would like to ask what proportion of the general run of incompetent lip cases the authors' thought cured themselves naturally when the patients reached about 13 or 14 years of age.

Mr. R. E. RIX said that he had much enjoyed both the papers, which were the best that he had listened to for a long time.

He had seldom heard said in public so many things that he wanted to hear.

There was one point which he wondered whether one ought to be very sure about, namely, the stability of the incisor apical relationship, or the dental base relation in the incisor region. It was known that as the age increased the difference between the SNA/SNB angles decreased; the face became prognathous, but at the same time the occlusal plane became more horizontal. He thought it would be found that the decreasing difference between the SNA/SNB angles did not always go hand in hand with that flattening out of the occlusal plane, and, if that was accepted, it was necessary also to accept the fact that the dental base relationship was not always as constant as it was thought to be.

Mr. H. G. WATKIN, in congratulating Mr. Ballard and Mr. Walther on their papers, said that the large audience showed how much the authors' ability was appreciated.

He thought that in some cases the tongue prevented the teeth from closing, and he used a lingual arch with a grid in front to prevent the tongue from pushing through the gap.

Mr. H. E. WILSON thanked Mr. Ballard and Mr. Walther for their papers and said that he was interested in the question of whether taking away the tongue thrust would have any effect on the abnormal swallow; in other words, whether the size of the tongue had any relation to its function.

All the cases which the authors had shown had been treated by fixed appliances, and he would like to ask them if they had treated any cases with an Andresen appliance or monobloc entirely and assessed the result afterwards. Following on from that, he would like to ask whether the authors had any theories on the movement of the condylar head in relation to the Fossa.

With regard to racial features, in New-

castle he had seen x-rays of some African students there. The lower incisor apical base angle was as much as 100° and the upper incisor apical base angle was about 110° plus, so, if 90° and 106° were taken as the standard for the white race, they varied a good deal in other faces.

Mr. C. F. BALLARD, in replying to the discussion, said that all the cases which he and Mr. Walther had shown were Class II cases. They both thought that the axial inclination of the labial segments was the most important part of the diagnosis. It might be that they would demonstrate that the dental base relationship changed a little—it might be for the better, or it might be for the worse in some high Frankfort mandibular plane cases—but clinical observations over more than ten years convinced him that, from the point of view of good functional incisor relationship, the axial inclination was the important thing, and that applied to the incisor overbite also. The incisor overbite was directly related to the axial inclination relationship of the upper and lower teeth—it was an occlusal relationship—and he could state fairly confidently that, if the angle between the upper and lower incisors went above 140° , there was bound to be an excessive incisor overbite which was untreatable. It was no use fitting a bite plate and depressing the lower teeth to open the incisor overbite; it would only relapse completely. The only way to control it was to change the axial relationship of the teeth. That answered the question about the shortening of the upper labial segment. The condition was untreatable as a result of the unsatisfactory angle between uppers and lowers on a Skeletal II dental base relationship.

When he had referred to the causes of dento-alveolar malrelations, he had not attempted to discuss the aetiology of soft tissue behaviour and abnormality in the skeletal morphology. He thought that in orthodontics aetiology could be considered under two headings. One was the factors

in soft tissue behaviour and skeletal morphology which resulted in the dento-alveolar abnormalities, and the other was the aetiology of such behaviours as the abnormal swallowing and incompetent lip actions and the causes of variations in skeletal morphology which produced the differences in dental base relationship. A discussion of the aetiology of the abnormal swallowing action would require several papers.

He thought that the question of the elasticity of the alveolus being a factor had been answered when he had pointed out that it was possible in some cases to move the lower labial segment forward 15° , from the point of view of proclination of the teeth, and there it stayed. He did not think that the alveolar bone had any elasticity. It was, as Brodie said, in equilibrium in soft tissue behaviour, and that was the important thing.

As to the question of abnormal swallowing being a consequence of dental abnormality, he could not discuss that in detail at the moment, but, if one considered the evolution of the swallowing behaviour, one had to admit that it must be present at birth as a mature pattern for the survival of the individual. As Gwynne-Evans had shown, there was little difference between the movement of the tongue in the infant and the movement of the tongue in the adult. He therefore thought that swallowing behaviour was mature before the alveolar structures developed from the dental bases into occlusion.

With regard to finger and thumb sucking being a potent cause of dental irregularities, very occasionally one found an individual who was such a persistent thumb sucker day and night, only taking the thumb out for the purpose of feeding, that the thumb sucking did produce an irregularity, but again this had a relation to the abnormal swallow. It was found clinically that the majority of cases of finger and thumb sucking which were associated with abnormality were associa-

ted with a Skeletal II pattern or abnormal swallowing, or both, and if the finger and thumb sucking ceased the irregularity remained. Also, it had been found that about ten times as many cases had the typical abnormal swallowing action without finger and thumb sucking. He thought that the abnormal swallowing action or the Skeletal II pattern with incompetent lip action was a far more potent cause of dental irregularity than sucking habits were.

He had seen cases in which if one superimposed on sella the mandibular dental base seemed to come forward a little more than the maxillary dental base during the period of treatment, but if one superimposed on Nasion one did not confirm this. As he had said at the beginning of his paper, he was attempting on the present occasion to stress the importance of labial segment inclination and was rather shelving the question of how much dental bases changed, because he thought that the changes were insignificant.

Mr. Softley had mentioned another important point that he had had to omit, namely, that the stability of the lower labial segment was dependent to a certain extent on the continuity of the lower arch. He had pointed out in a previous paper that if the lower 4's were extracted the lower labial segment dropped lingually. He would not like to make a definite statement on the extent to which the lower labial segment dropped lingually if there was loss of continuity of the lower arch, but, referring to axial inclination and degrees of change, he would say that the lingual collapse of the lower labial segment following loss of continuity in the lower arch was about 4° or 5° .

The question of incompetent lip action in high Frankfort mandibular plane angle cases brought him back to the assessment of the individual as a whole from the point of view of dento-alveolar malrelations. Incompetent lip action, he thought, was the result of a discrepancy between soft

tissue morphology and skeletal morphology. The people with the high mandibular plane angle were the long-faced individuals, and it was those cases that tended to have incompetent lip action.

He found it difficult to answer Mr. Tait's question about assessing the type of swallowing action, because he had not had any clear-cut picture in his mind of the various types of abnormal swallowing action, except the three very broad groups, two of which he had mentioned, the one in which the tip of the tongue came forward against the contracted lower lip and the other in which the anterior border of the tongue oozed through against the lower lip. The third one, which had been described by Mr. Rix, was that in which the sides of the tongue oozed between the cheek teeth, because they were apart during swallowing. He assessed the abnormal swallowing action in the same way as Mr. Rix had described, but he did not take so much note of the swallow after the individual had said "One, two" as he did of the swallowing action which the individual performed before he said "One, two" to clear saliva from the oral cavity. The swallowing action which the individual did immediately afterwards and which he did deliberately was liable to be a little forced.

With regard to the question of incisor contact to which Mr. Tulley had referred, he did not find that there was always a reduced overbite in the abnormal swallow cases; in other words, he found Class II, Division 1 cases with the lower incisors in contact with the roof of the mouth or the upper incisors, but they swallowed with the teeth apart. An investigation should be carried out (he hoped to be able to do it) to relate the position in which the mandible was fixed, so that the mylohyoid could work and lift the tongue, to the occlusal position and to the physiological rest position of the mandible.

In reply to Mr. Gardiner's question whether incompetent lip cases cured

themselves at the age of 13 or 14 years, he would say that, with his rather rigid diagnosis of incompetent lip action, the cases never cured themselves. That was entirely different from the patients learning to keep their lips closed. Many of them, especially girls, learned to keep their lips closed at the age of 13 or 14, when they became interested in their appearance, but they did so by a conscious effort to contract the orbicularis oris and the mentalis. At the Eastman Dental Hospital he had seen cases in the age group 30-40 which he had had sent to him by the Periodontal Department, because the upper incisors had started to move forward. The patients were usually married women with three or four children. As a rule they had had orthodontic treatment or had corrected a proclination by a conscious effort to keep their lips closed at the age of 13 or 14, and they had maintained the lips closed posture by contraction until their appearance was no longer so important to themselves; they had then reverted to their inherent physiological rest position. It might be that in a couple of years' time the physiologists who were interested in such problems would criticise him for using the expression "physiological rest position," but he was quite sure that they would not be able to disprove his clinical observations.

He thought that he had answered Mr. Rix's question on the dental base relationship. It would probably be shown that the dental base relationship changed, but not to any significant amount. He wished that it would change more, because then it would be easy to treat the cases by posturing the mandible forward. It had been shown that some individuals postured their mandibles forward to overcome incompetent lip action. What better function could one have if function could alter forms? But in fact those condyles did not grow back. The individuals could always move their mandibles back a full unit.

He knew the double oral screen that

Mr. Watkin had described, but he thought that an Andresen appliance was better for controlling the tongue thrust.

With regard to Mr. Wilson's remarks, he did not think that in a case of abnormal swallow behaviour the tongue was always too large, because one sometimes saw a very small tongue thrust through very vigorously and a very large tongue not thrust at all. He believed that it was right to call an abnormal swallow an innate behaviour pattern; in other words, he believed that the individual inherited and was born with this neuro-muscular pattern.

He and his colleagues had treated a series of cases with Andresen appliances and from the point of view of the cephalometric analysis they showed exactly the same changes as were shown by cases treated with fixed appliances.

Unfortunately the Andresen appliance would produce a beautiful occlusion with the mandible postured one unit forward, and unless one was careful to check this one might think that the result was very good, and then the case would relapse.

An important factor in incisor relationship was the actual change of axial inclination of the teeth on the dental base. In treating Class II, Division 1 incisor relation, if one pulled back a proclinated upper labial segment by force applied near the tips of the upper incisors the apices would move forward more than the crowns moved back. The result was, of course, a retroclinated upper incisor, a high angle between the upper and lower incisors and an excessive overbite, which was quite unnecessary. That finding in fact argued for a full band technique in many cases. In other words, one should control the labial movement of the apices of the upper incisors if one wished to produce the best possible result particularly in Class II, Division 1 occlusions on Class II dental base relationship.

Mr. D. P. WALTHER, in replying to the discussion on his paper, said he thought

the only question he had to answer concerned the last two cases that he had shown, Nos. 4 and 5. These cases were two sisters. In both cases he had used the lower lingual arch. The elder sister (case No. 4) had only very slight imbrication of the lower right 5 and it was necessary

to make only a little space in order to get it in. In the case of the younger sister it was necessary to obtain a considerable amount of room, so he had to procline the lower incisors and upright the 6's considerably. He had also used intermaxillary traction.



Examples of Specialist and Non-Specialist Orthodontic Treatment

W. H. LITTLEFIELD, B.D.S., H.D.D.

SIX PAIRS of treated orthodontic cases were demonstrated (twelve cases in all). In each pair one case which had received specialist orthodontic treatment was compared with the other which had been treated by non-specialist methods. In this way it was shown that, whilst severe malocclusions require specialized treatment by an orthodontist, those which are less severe often respond to simple treatment which is within the province of the general practitioner.

One pair of cases is described here as an example of the demonstration.

The first case (*Fig. 1*) showed a severe Angle's Class 1 malocclusion with separation and imbrication of the upper



FIGURE 2



FIGURE 1

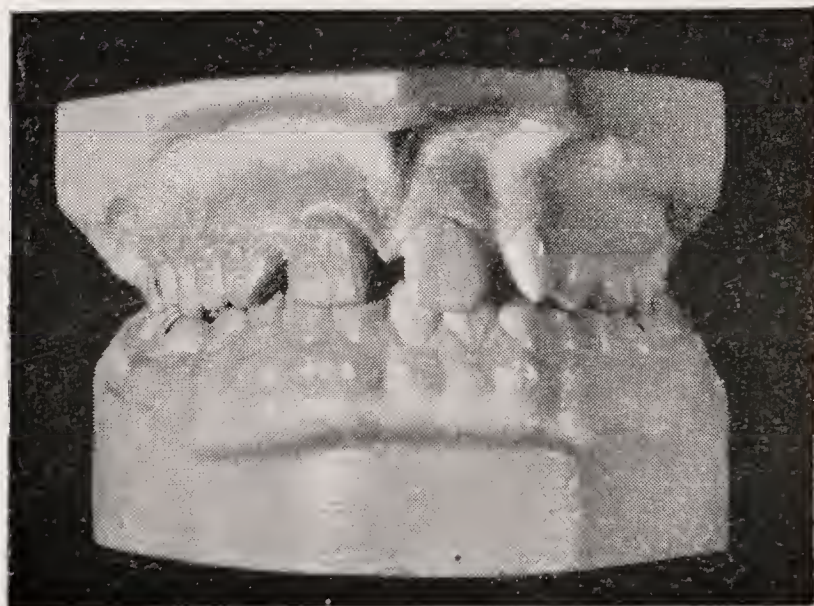


FIGURE 3

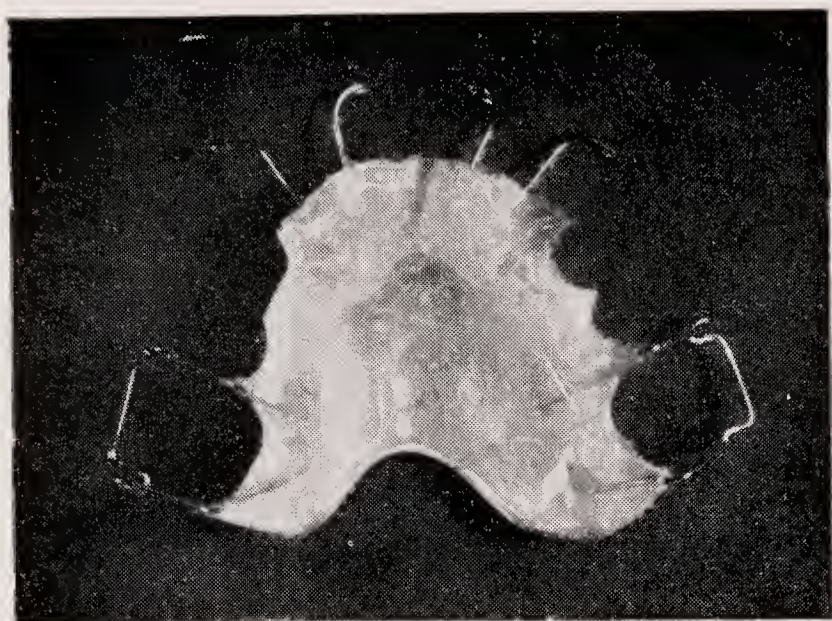


FIGURE 4



FIGURE 5

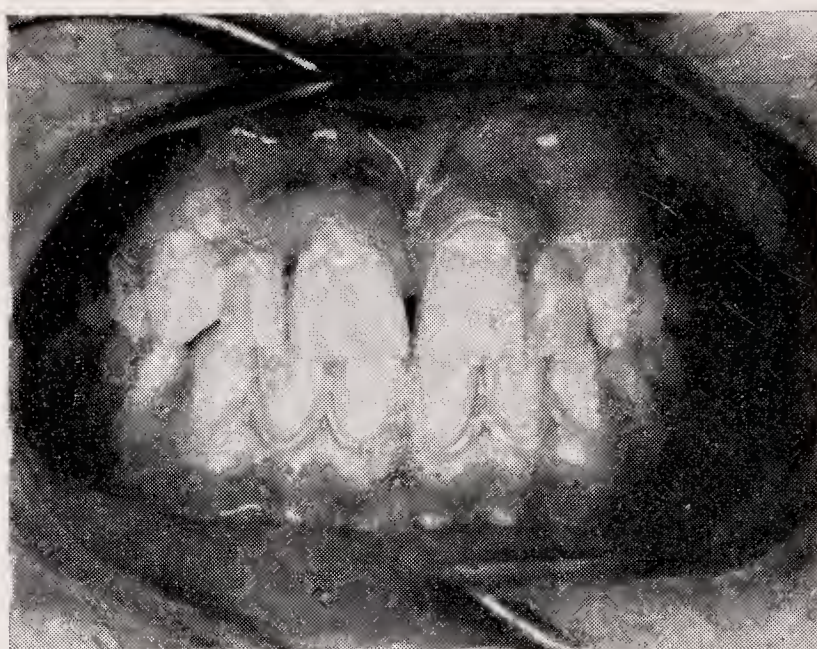


FIGURE 6

incisors due to the presence of a supernumerary tooth. In addition there was a forward movement of the first permanent molars. The supernumerary tooth and the four first premolars were extracted and a fixed appliance with a twin arch was used to align the upper incisors. Models taken after the completion of the treatment are shown in *Figure 2*.

This case was then compared with the second of the pair which showed a less severe but somewhat similar type of malocclusion (*Fig. 3*). Here again the

upper central incisors were separated, this time due to a persistent labial fraenum and absence of the laterals. In addition the upper canines had moved mesially. After removal of the fraenum the central incisors were approximated and the canines moved distally by means of finger springs on a simple removable appliance (*Fig. 4*). Models taken after the completion of the treatment are shown in *Figure 5*. Orthodontic treatment was followed by the provision of an upper partial denture (*Fig. 6*).

Orthodontics and the Older Teen-ager

R. OSBORNE HELLIER, L.D.S.

IN THE practice of Orthodontics, frequently one talks with parents who have the impression that because their child is over thirteen, it is not possible to have the teeth straightened. On occasion, in a gathering of colleagues, one has heard the opinion expressed that because the patient is fourteen or so, it is inadvisable to start an orthodontic treatment. It is difficult to understand the origin of the opinion of the general practitioner but it would appear the impression gained by the laity is directly derived from this opinion.

Salzmann holds the opinion that late treatment is possible when performed in accordance with natural functional forces and with due consideration to the differences of bone as found in the child and in the adult. He thinks also that, individual tooth movement by means of mechanical appliances may be performed provided this change in position of the teeth brings them in a more favourable position as far as function is concerned.

Age in itself does not necessarily contraindicate orthodontic treatment. Because of this patients of fourteen and over should not be turned away without further thought. They should be investigated, diagnosed and fully considered before telling the anxious parent, and maybe the more anxious child, "It's too late now."

To demonstrate that the older teen-ager can be successfully treated orthodontically, five treated cases were shown aged 14 to 18 years at the start of treatment. In all but one case they had been out of retention for 12 months or more and the amount of relapse seen did not seriously effect the result. In general there was a marked improvement in the appearance and the function of the teeth, and also in the gingival tonus.

The accompanying photographs illustrate two of the cases presented.

SYNOPSIS OF CASE HISTORIES

Case 2 (male) Age at start (Models A)

14 yrs. 6 months.

Age at completion (Models B)
16 yrs. 10 months.

The patient had received unsuccessful treatment at 12 yrs., and presented himself with the dentition shown in models "A". Treatment was effected by re-creating $\frac{5}{5}$ space and retracting $\frac{3}{3}$ followed by $\frac{21}{12}$. The resultant upper buccal spacing was closed by moving $\frac{765}{567}$ mesially. Fixed and removable appliances were used.

Eighteen months after all retention was removed, no relapse was observed.

Case 4 (female) Age at start (Models A)
17 yrs. 5 months.

A

B

CASE 2

A

B

CASE 4

Age at completion (Models B)
19 yrs. 3 months.

This patient was much upset by her appearance and could not speak of it without emotion. She stated that three years before she had been told by a dentist that nothing could be done to straighten the teeth. The paradontal condition of $\overline{1}$ was found to be hopelessly bad. The treatment was effected by removing $\frac{4}{4}$, $\frac{5}{1}$ and aligning the incisors to best advantage,

and moving $\overline{4/5}$ linguallly. Removable and fixed appliances were used.

The relapse observed eighteen months after retention had been removed was an imbrication of $\overline{1/}$ and $\overline{2}$ with a slight change in the axial inclination of the upper incisors to correspond.

The improved appearance, function, and gingival tonus were unimpaired by the relapse.

The improved mental outlook of the patient remained unaffected also.



Some Edgewise Techniques and Cases Treated with the Edgewise Appliance

MAJOR P. J. CEREMELLO, D.D.S.

Technique casts were shown with edgewise bands in place illustrating various methods for closure of premolar extraction spaces, band placement, use of single width, double width, and twin edgewise brackets, coiled springs, elastic traction, Bull loops, rotating springs, rotating

staples and arch wire tie-backs.

Facial and plaster cast photographs were shown of patients before and after treatment with the edgewise appliance. These comprised Angle Class I and Class II cases, illustrating facial as well as dental changes.



FIGURE 1
Illustrates dental change

A demonstration given at the meeting in May



FIGURE 2
Illustrates facial change

Electric Soldering

S. E. WALLIS, L.D.S. R.C.S. (*Eng.*)

A DEMONSTRATION of simple Electric Soldering which showed to be of great value especially in soldering stainless steel wires of unequal thickness.

- e.g. i external bow 0.7 mm. with small spring attachment 0.35 mm. for canine movement.
- ii attach 1 mm. wire to 0.3 or 0.35 mm. wire in the construction of a Friel Spring.

The advantage of soldering in this way is that the wire is in no way either oxidized

or burned therefore the temper of the wire is retained.

The apparatus is used as follows: the thicker wire is held by small screws between the positive and negative terminals. A small horse-shoe of stainless steel solder wire is placed at the point to be soldered. Stainless steel flux is applied and then the current switched on by a foot switch. As soon as the thicker wire is heated sufficiently and the horse-shoe of solder melted the smaller spring is "touched on" giving a neat and strong soldered joint.

Given at the demonstration meeting on 4th May 1953

Methods of Recording Patterns of Behaviour of the Oro-Facial Muscles Using the Electromyograph

W. J. TULLEY, B.D.S., F.D.S.R.C.S.

Guy's Hospital Dental School

During the past few years increasing emphasis has been placed on the part played by the soft tissues surrounding the dental arches in the alignment of teeth. Previous investigations had concentrated mainly on such functions as chewing and sucking which produce only intermittent influence on the developing dental arches. Rix, in a paper read before the B.S.S.O. in 1946, particularly focused attention on the behaviour of the tongue, lips and cheeks during swallowing, emphasizing that this is an activity which continues both day and night. He pointed out that in view of the frequency of this act of swallowing it must be one of the factors influencing profoundly the position of the dento-alveolar structures. Gwynne-Evans and Ballard have read papers before the B.S.S.O. dealing with aspects of this subject and the behaviour of the soft tissues in feeding, breathing and the more complex patterns of speech.

It has been the author's privilege to work with Rix and Gwynne-Evans for the past five years and to be closely associated with their investigations.

Last year Rix read a paper before this Society in which he analysed details of atypical swallowing patterns in relation to various types of malocclusion and suggested that the atypical behaviour is

akin to the infantile suckling pattern. Gwynne-Evans has likened the peristaltic type of activity seen in the atypical swallow to an autonomic or visceral type of behaviour. Quote :— "Remembering that the orofacial muscles occupy a functional position between the somatic and visceral types of behaviour, it would seem that some children emphasise the latter in their swallowing movements more than others. The two types of behaviour are so frequently seen that it is difficult to say which is normal and which is abnormal. It would be tempting to refer to the one as the "somatic type" and to the other as the "visceral type", but for the present it is safer merely to recognise them and to say that one is often associated with a normal occlusion and the other with an abnormal occlusion between the teeth". Ballard believes that these patterns are often genetic in origin.

So far, the experimental work in these soft tissue patterns has consisted of clinical observations and serial cinefilms taken in slow motion to allow analysis to be made frame by frame. One of the main difficulties is to carry out the examination of the child without interfering with natural activities as children are very liable to cheat if they know what is being looked for.

There are two main outstanding clinical problems—

- 1) To what extent can these patterns be modified by exercises and appliances ?
- 2) Are these patterns still found in adults in as high a proportion as in children between the ages of eight and twelve years ?

In the Medical School at Guy's, Gwynne-Evans and the author have, over the past four years, been studying the first of these problems by serial cine-photographs of children under treatment in the Dental Department for Children, Guy's Hospital. It is still early to give any definite answer but it can be stated that modifications of patterns do occur following Orthodontic treatment in some cases and enable the

resulting occlusion to be stable. There are other patterns which are quite resistant to any change. Obviously the seemingly simple exercises described by some writers are by no means a complete answer.

There is no difficulty in observing clinically the more extreme activities of lips and tongue in swallowing which are seen in some children but assessment in other cases has been difficult. If a scientific evaluation could be made of these patterns by producing tracings of the general activity in a way comparable to that used for other muscles, further investigations could be made. After several trials with a small sample of patients a method was evolved using the electromyograph.

This is an instrument which amplifies the small changes in potentials which develop when a muscle is contracting. Therefore a study can be made of the degree and force of muscle activity. Fig. 1 shows the actual apparatus. It is a two channel electromyograph with which two muscles or muscle groups can be studied at the same time. Incorporated in the lead from the electrodes are rubber tubes which are connected to a suction pump. The main amplifier is housed on the left hand side of the apparatus and is capable of an amplification of 10^6 . The action potentials are recorded on a moving trace on the cathode ray tube and can be reproduced on a film by means of a camera housed in the apparatus which photographs the same trace on a second cathode ray tube. Meters are available to read the mean and peak potentials.

It is important to eliminate outside electrical interference by isolating and screening the apparatus and the patient is earthed by a lead to the forearm. There is always a very slight internal interference known as the amplifier "noise" but it does not interfere with recordings as it is of a very low order. (Fig. 8)

In the choice of electrodes one has to choose between the use of needles and surface electrodes applied by adhesion.

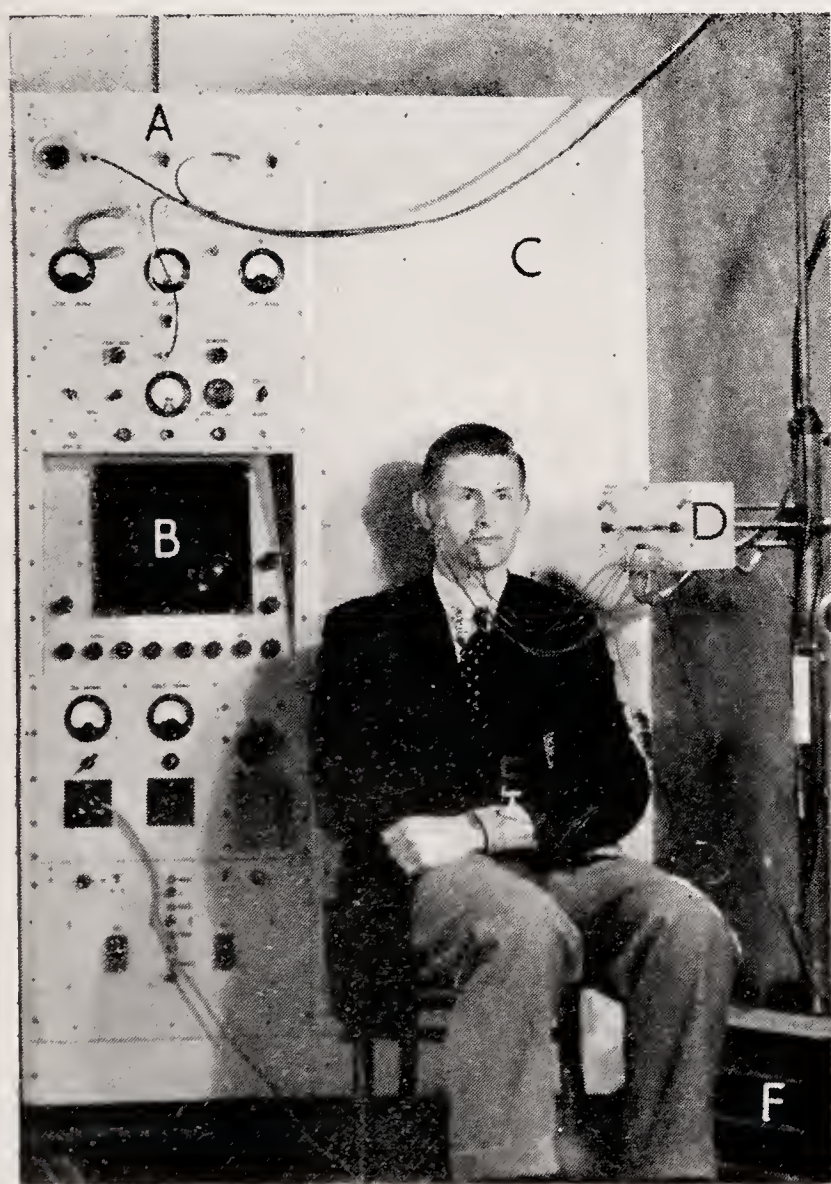


FIGURE 1

THE TWO CHANNEL ELECTROMYOGRAPH

- A. The amplifier.
- B. The Cathode Ray Tube.
- C. The Recording apparatus.
- D. The pre-amplifier and electrodes.
- E. The earth lead.
- F. The Suction pump.

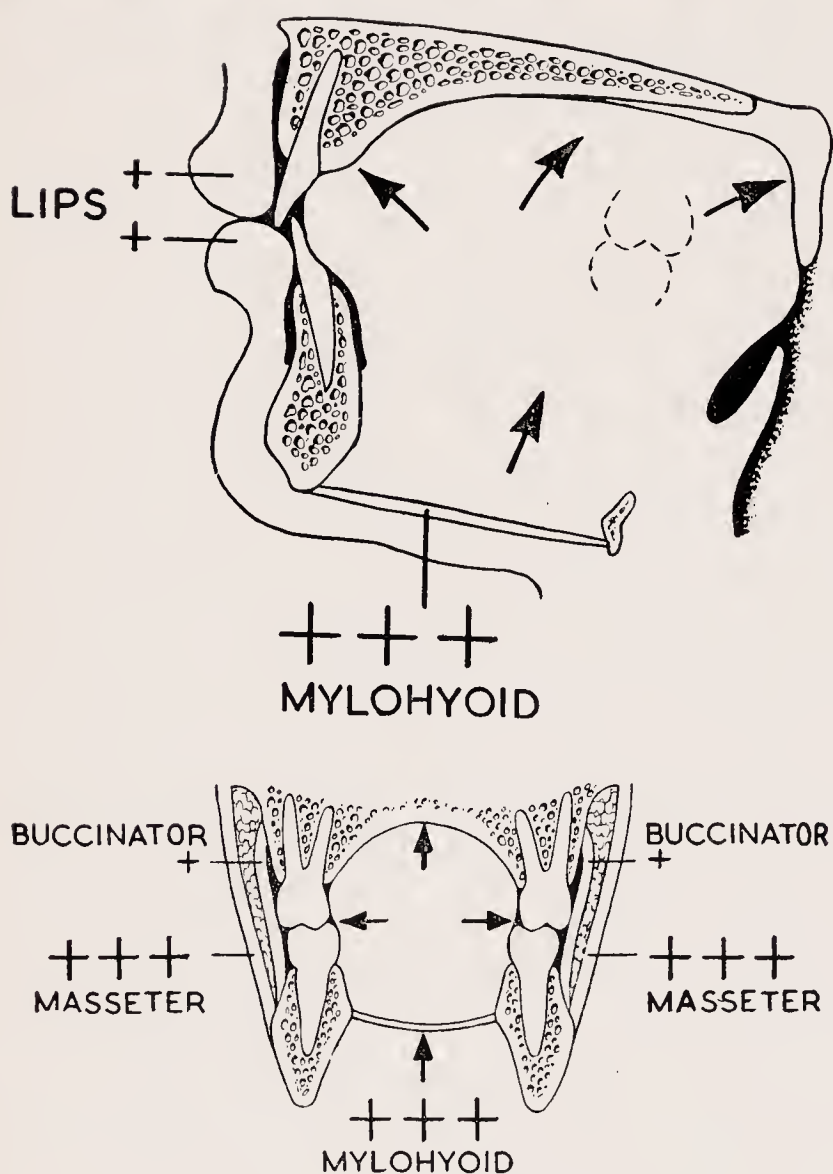


*Lips separated at
moment
of swallowing.*

FIGURE 2

**'THE TEETH TOGETHER
SWALLOW'**

(Mylohyoid Phase) extracted cine-frames and diagrams illustrating the lack of circumoral contraction and the behaviour of the tongue.



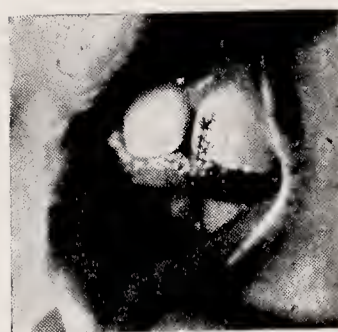
It might be said that the presence of these electrodes would interfere with the normal activity but the technique used is the same in each case and the number recorded should eliminate errors.

Figs. 2 & 3 show actual and diagrammatic representations of the behaviour of the muscles surrounding the dental arches in what have been described as the normal and atypical patterns of swallowing. In Fig. 2 the diagram is deliberately exaggerated to show how the masseter contracts forcibly at the mylohyoid stage of the normal swallow as described by Whillis, to give a fixation for the mylohyoid. The tongue is contained within the dental arches and it is thrust into the palatal vault and squeezed back into the oro-pharynx. The circumoral muscles play very little part in this behaviour. In Fig. 3 showing the atypical behaviour there is not the same forceful contraction of the masseter at the mylohyoid stage and the food tends to be bolted by the peristaltic type of flow from the mouth to the oropharynx. The pattern of the oro-facial muscles varies in these cases. The buccinator and the circumoral muscles contract to complete the lateral and anterior boundaries of the mouth and in the particular illustration the lower lip contracts forcibly under the upper incisor to meet the tip of the tongue.

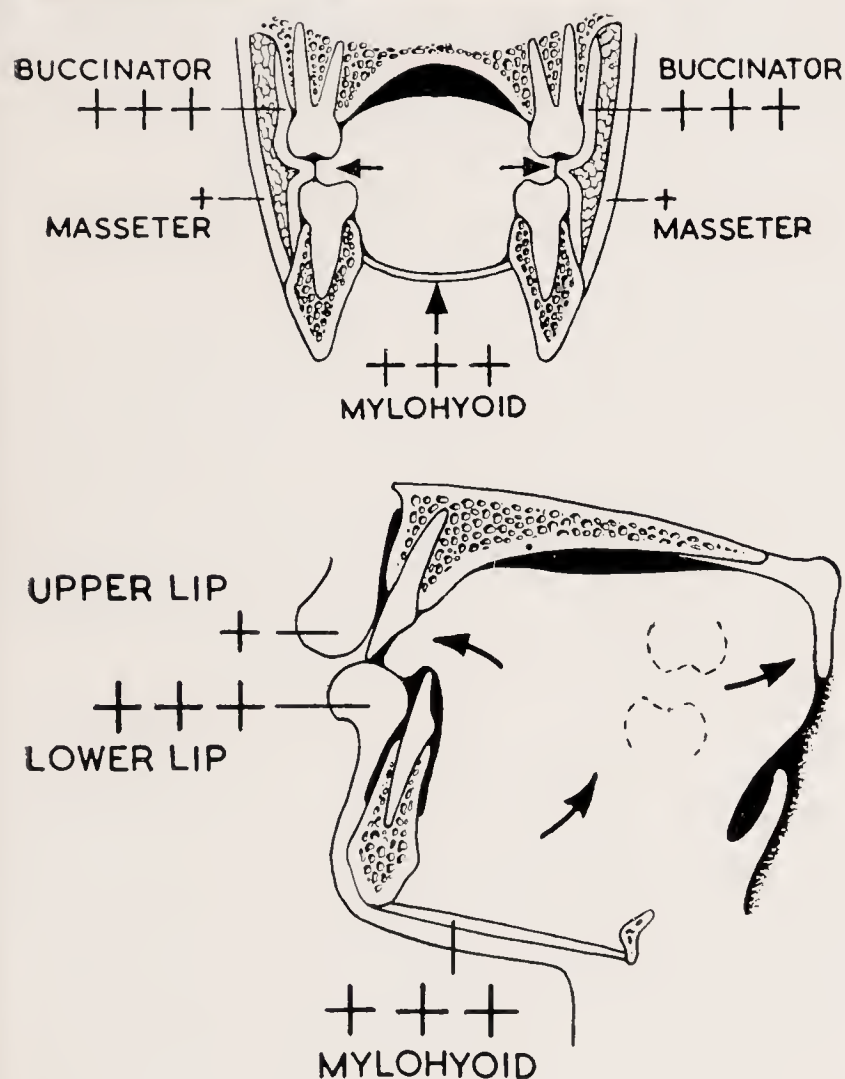
The potentialities of the two types have been investigated by several workers and the use of needle electrodes found to be too selective and likely to worry the patient unduly in the type of investigation that was envisaged.

Moyers, when investigating the finer details of muscle activity controlling the temporo-mandibular articulation required much more detail, but this investigation is concerned only with the general pattern of behaviour and therefore surface electrodes which are kept in place by suction are used.

From a study of a number of children with the normal or "somatic type" of swallowing behaviour in contrast with those who exhibit the atypical or "visceral type" of behaviour it was seen that if a recording could be taken from the masseter and the group of circumoral muscles in the



Lips separated at moment of swallowing.



two types at the mylohyoid phase there would be obtained a general pattern of activity which would reflect the type of swallowing behaviour. The normal swallower would show marked masseteric contraction with little circumoral activity (Fig. 4) whereas in the atypical type of activity the reverse pattern is seen. (Fig. 5)

In order to make these recordings the subject is placed in a chair close to the apparatus. Electrodes are placed on the masseter, one just below the zygoma and the other 1 inch from the angle of the jaw. (Figs. 1, 4, 5) The electrode on each lip is placed just medial to the angle of the

FIGURE 3

THE TEETH APART OR ATYPICAL SWALLOWING BEHAVIOUR (Mylohyoid Phase)

Extracted cineframes and diagrams illustrating the marked circumoral contraction and one of the variations of tongue behaviour in this group.

mouth but not too near the midline to interfere with eating and drinking. Admittedly in this position the full contraction of the mentalis muscle is not recorded but a fair picture of the circumoral activity is obtained.

The patient is asked to relax as much as possible and is then observed carefully, one or two basic swallows are easily recorded in a few minutes. It is essential by giving frequent drinks to prevent the subject from getting a dry mouth. If the mouth is dry the subject will automatically suck in his lips to assist salivation.

Similar recordings are taken with the subject chewing and swallowing a piece of biscuit. (Fig. 6) In order to have a control these recordings are checked against those obtained when the subject is swallowing succulent fruit and when sipping from a cup. These will produce a record similar to the atypical behaviour in all subjects.

It is the sucking swallow described by Rix in his original paper.

Preliminary results from a research project incorporating this technique are now available. The material consists of 100 preclinical dental students who possess no knowledge of orthodontics. The object has been to see if the atypical type of behaviour is found in the young adult and whether it is related to any existing or treated malocclusion. In addition to the electromyograph a full history, lateral skull X-rays and models are taken of each subject.

So far, only 40 have been investigated or are in the process of being studied. Of these, 15 exhibit the classical behaviour, 10 the obviously atypical behaviour, and

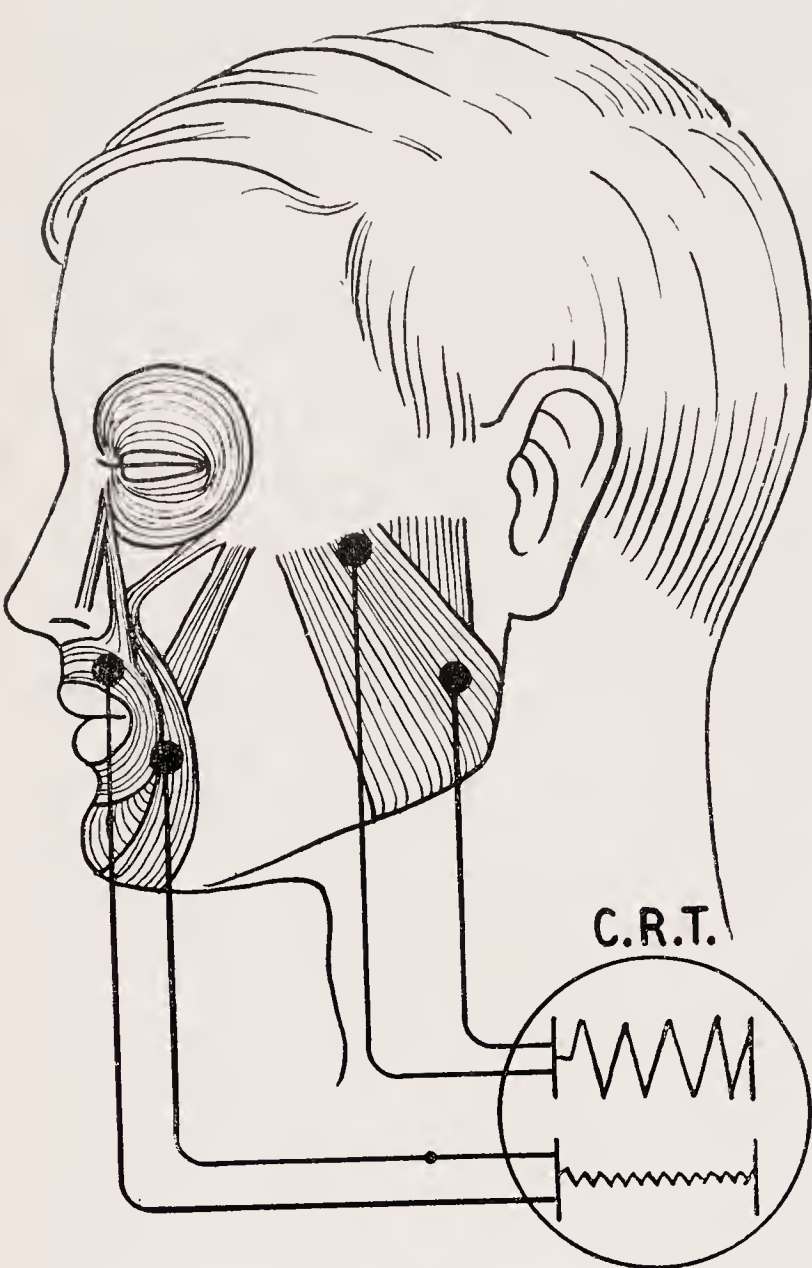


FIGURE 4A

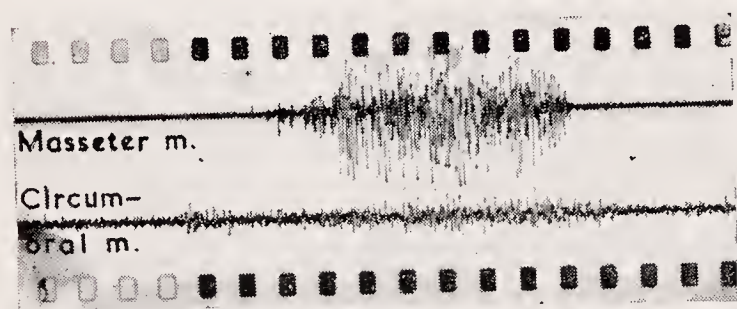


FIGURE 4B

*A. Diagram illustrating the method of recording the behaviour pattern of the oral-facial muscles in swallowing (The normal behaviour).
B. An actual recording of the "normal" swallowing behaviour showing the marked masseteric contraction.*

15 show a behaviour which is mainly normal with occasional lapses. This latter group never occlude their teeth with the same vigour as the classical group and use their lips nearly as much as the masseter. It would be tempting to suggest that they are examples of modification of pattern but the evidence is too slender as yet.

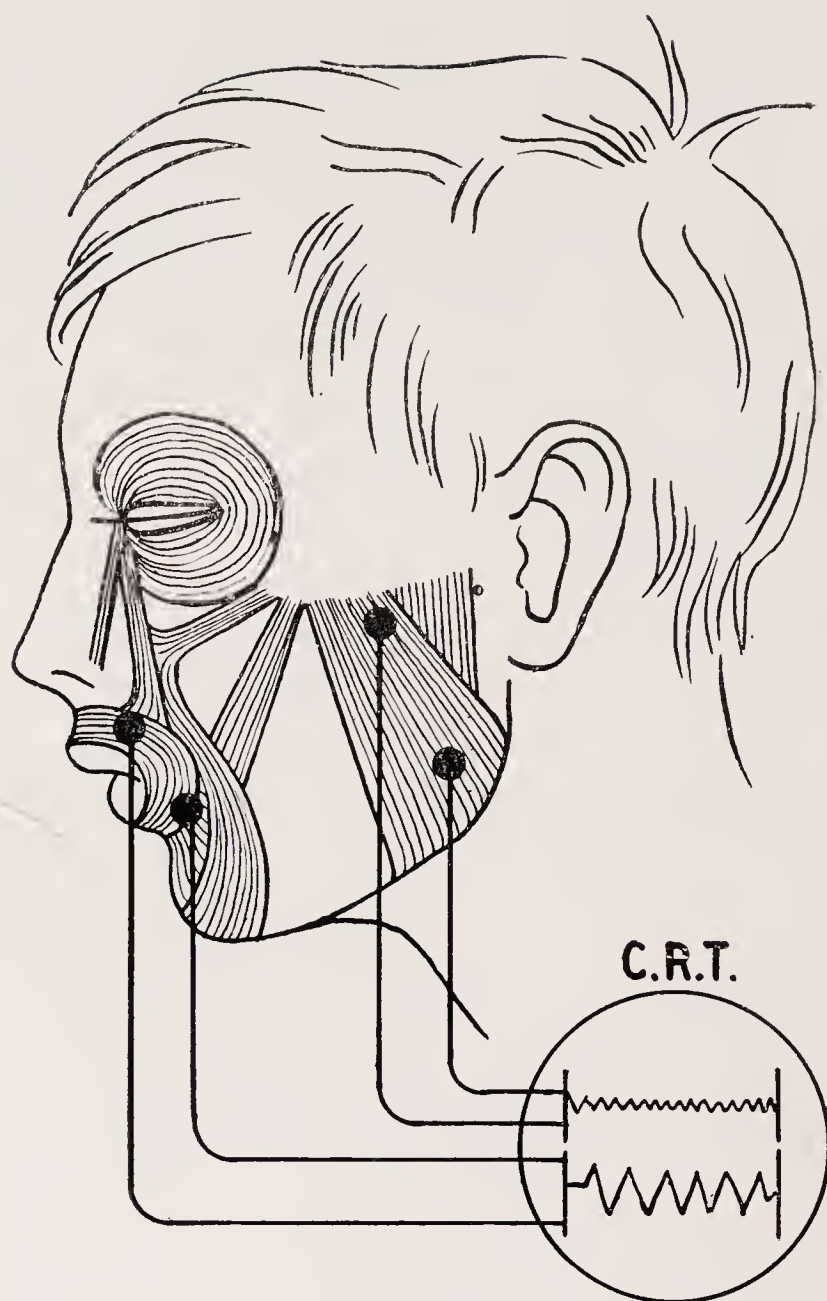


FIGURE 5A

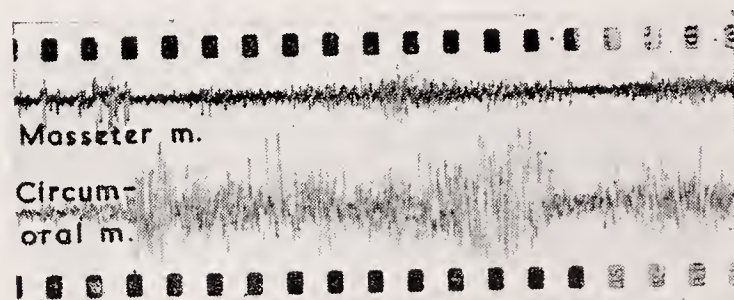
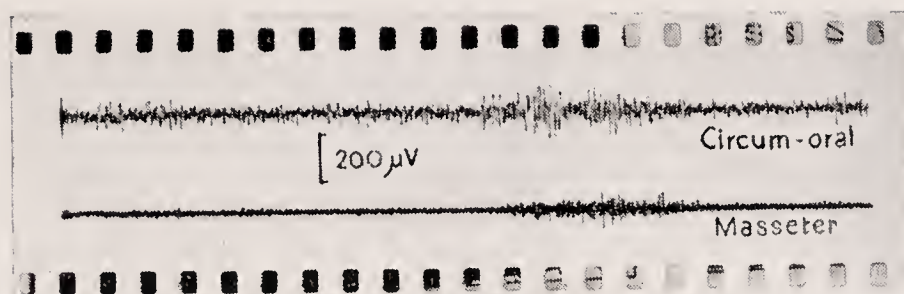


FIGURE 5B

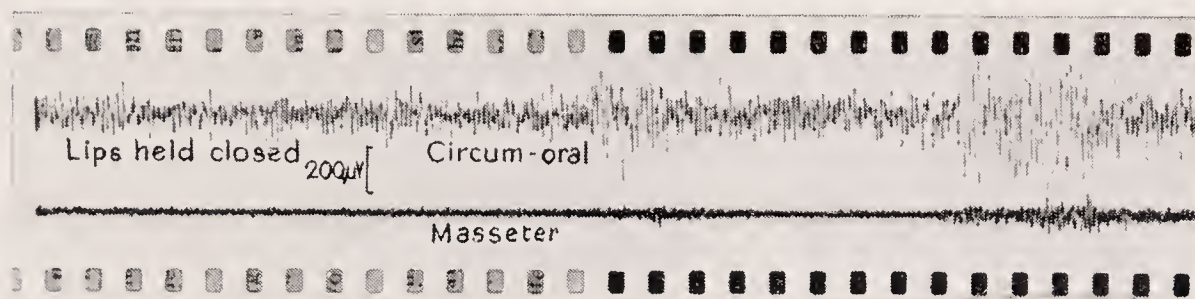
*A. Diagram illustrating the method of recording the behaviour pattern of the oral-facial muscles in swallowing, (the atypical behaviour).
B. An actual recording of the "atypical behaviour" showing the marked circumoral contraction.*

No attempt has been made to analyse the occlusion of these subjects. This will require a more detailed study later. All that can be said at the present time is that, in those cases presenting the atypical behaviour in its most obvious form, a marked degree of malocclusion is still present.



(Relaxed with lips together)
A. D.S. aged 9 years.

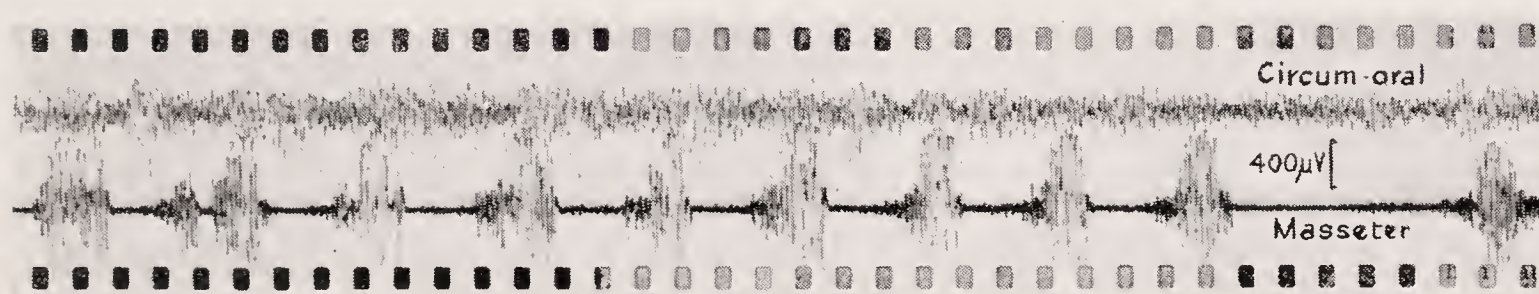
(swallow)
Basic swallow.



(with lips together)
B. J.S. aged 9 years.

(swallow)
Basic swallow.

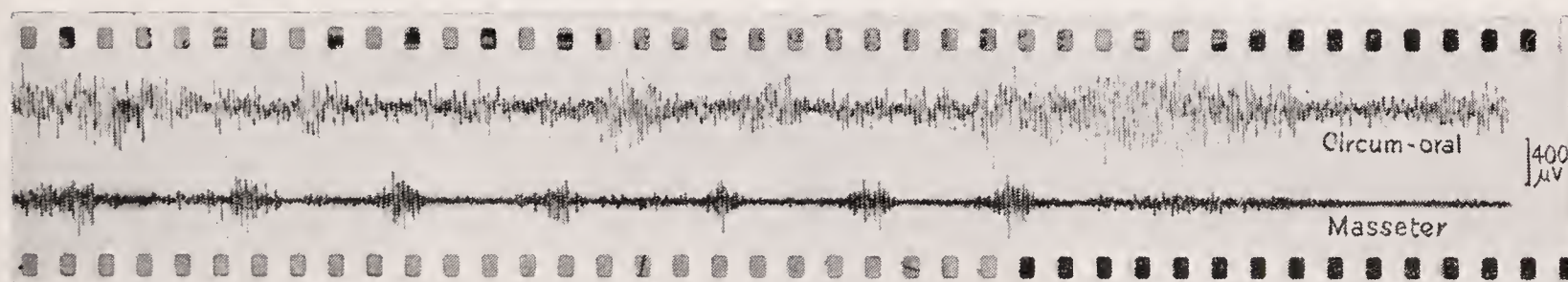
(swallow)



(chewing)

A. D.S. Chewing a biscuit and then swallowing.

(swallow)



(chewing)

B. J.S. Chewing a biscuit and then swallowing.

(swallow)

FIGURE 6

A recording of the swallowing and chewing behaviour of fraternal twins showing the difference in patterns.

It is noted that J.S. shows a definite atypical behaviour compared with his brother although neither of them occlude their teeth in the basic swallowing behaviour J.S. has to make an effort to seal his lips by active contraction of the circum-oral muscles (trace 11). He does not chew his food with as much vigour as his brother and in swallowing shows a marked circum-oral contraction.

Other information which is important to the Orthodontist can be obtained with this apparatus. It is possible to take recordings from the masseter while the monobloc is being worn comparing different degrees of bite opening and posture to see which gives the most effective activating force. It is also possible to assess the change in behaviour before and after treatment. Eschler has already published work

in Germany showing recordings taken with children sleeping with the monobloc and assessing its efficiency. Ballard has shown how the electromyograph may be used to demonstrate the degree of circumoral contraction necessary to enable a child with "incompetent lips" to effect a seal.

It is also possible to attempt to compare activities in masseter and temporalis in different patients, when the mandible is in

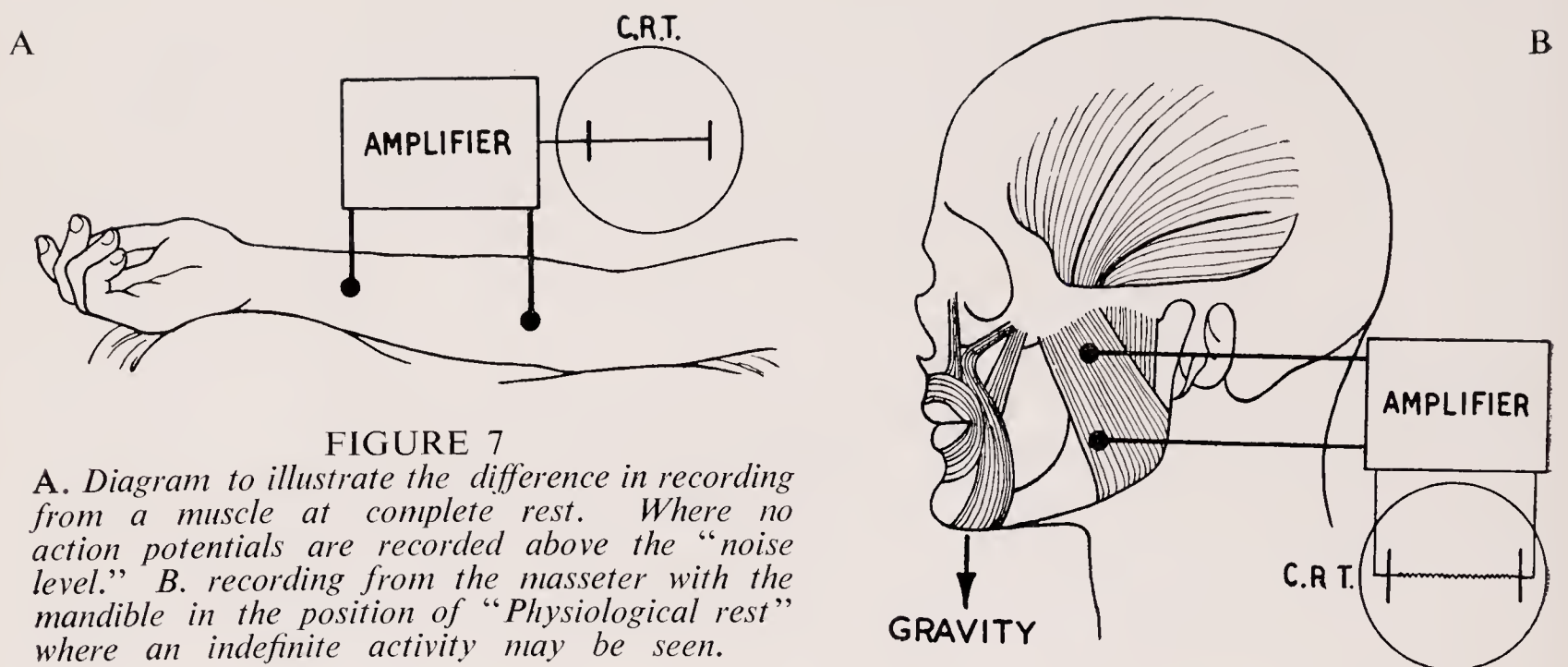


FIGURE 7

A. Diagram to illustrate the difference in recording from a muscle at complete rest. Where no action potentials are recorded above the "noise level." B. recording from the masseter with the mandible in the position of "Physiological rest" where an indefinite activity may be seen.

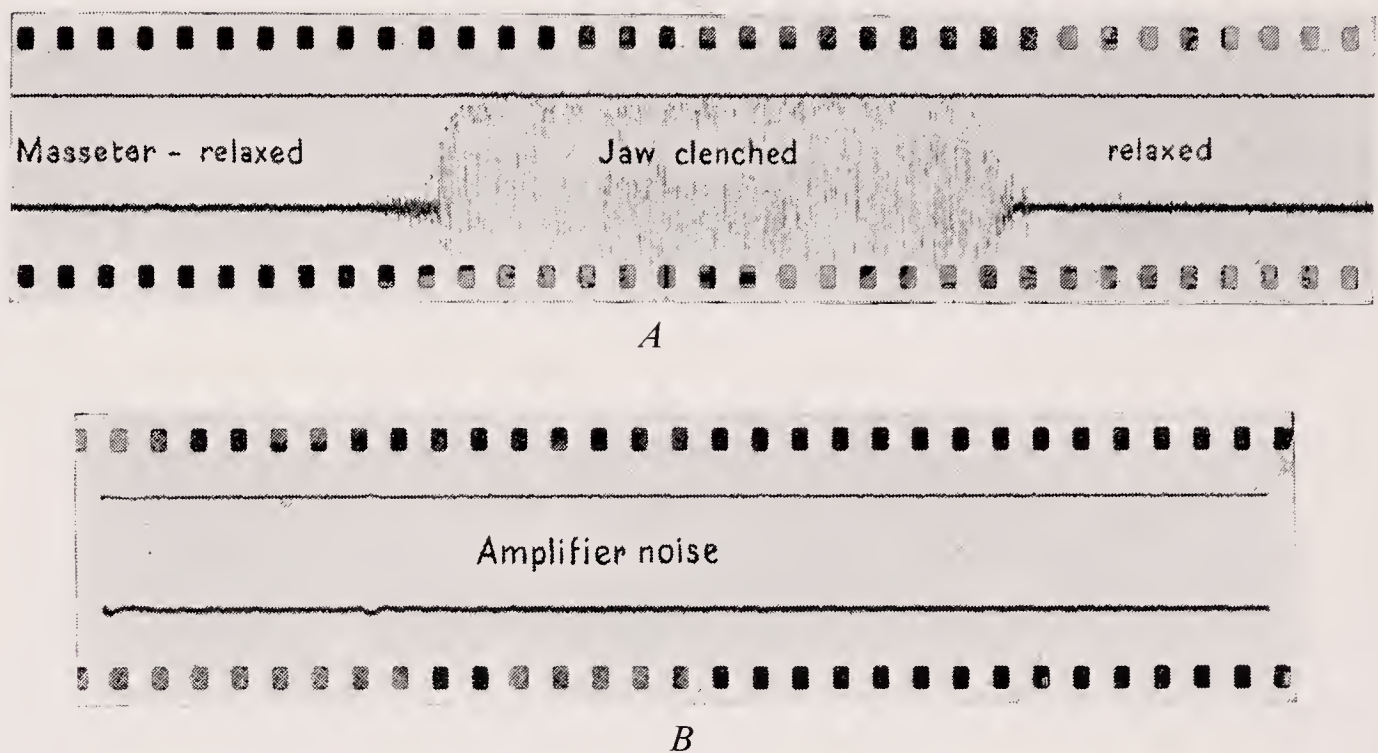


FIGURE 8

A. Indefinite activity recorded from masseter when the mandible is in the position of physiological rest. Also the maximum masseteric contraction with full amplification.
B. Slight internal interference from amplifier which cannot be eliminated. This is known as the amplifier "noise."

the so called position of physiological rest. The electrical activity recorded in these cases varies but it is of such a small order that it is difficult to assess. (Fig. 7 and 8b) Any activity above the noise level should not be ascribed to "resting tonus". This is an erroneous term because the muscles are actually doing work supporting the weight of the mandible against gravity and they are assisted by a sling of the facial muscles. All these are part of a chain of muscles maintaining the posture of the head described by Thompson & Brodie. We must

not ignore the part played by the facial muscles in supporting the mandible. In a personal communication to the author Russell Logan has described a most interesting case where the fifth nerve was effected by bulbar poliomyelitis and the sling of facial muscles illustrated in Fig. 7 hypertrophied to such an extent that the mandible could be actively elevated by them.

The use of the word "tonus" should now be reserved for the intrinsic property of a muscle at complete rest, which is lost

only when the nerve is sectioned or in deep anaesthesia. The electromyograph is not able to show any significant action potential from a resting muscle. It may be that the amplifier "noise", which is never completely eliminated, masks action potentials of a low amplitude but that still remains to be demonstrated. (Fig. 7) This aspect of muscle physiology is still controversial and is better not stressed too strongly, but from the Orthodontists' point of view the electromyograph demonstrates the dynamics of the muscles surrounding the dental arches and illustrates the fact that they are rarely in physiological rest.

Consider a man relaxing in a chair and reading a newspaper, his facial musculature is not in repose, but is reflecting his ideas on the news. Relatively relaxed facial musculature may be seen in a child but the stress of modern life may create a tightlipped, jaw clenching adult.

THE FILM

The film was divided into two parts. The first part showed three cases filmed at yearly intervals. The first case had a very marked atypical swallow but the occlusion was not very disturbed. The patient was not treated and a modification of pattern was seen after three years. The second case, (class 11 division 1) showed a modification of swallowing pattern after treatment with a monobloc. The third case (class 1) had been treated with a monobloc as an intra oral screen for three years but the swallowing pattern remained the same.

The second part of the film illustrated the method of recording using the electromyograph.

SUMMARY

A method of studying the behaviour patterns of the muscles has been described using the electromyograph. It is of course not intended to be anything but a research

tool as clinical observation must be the basis of diagnosis.

It has been shown that a proportion of young adults exhibit the atypical type of swallowing behaviour and the film has shown that although the patterns may be modified in time and with treatment they are often very resistant to complete change.

What is important clinically is that often the modifications allow the results of treatment to be stable.

ACKNOWLEDGEMENTS

My thanks are due to Mr. Rix and Mr. Pringle for their help and permission to show cases under their care at Guy's Hospital; to Mr. Gwynne-Evans for his encouragement and permission to use film material from the Upper Respiratory Research Unit; to Mr. Nightingale and Mr. Battye for help and permission to use the electromyograph which they have developed; to the Department of Medical Illustration Guy's Hospital for the illustrations and to the Dental Photographic Department for the filming of part 11.

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DISCUSSION

The PRESIDENT said that Mr. Tulley's paper was extremely interesting and had been very well presented.

Mr. R. E. RIX, in opening the discussion said that it was kind of Mr. Tulley to give him the opportunity of opening the discussion on his work, for he was very interested in the behaviour of the muscles attached to the jaws. The more accurately this behaviour could be recognised and recorded the more accurately could its effect upon the general morphology of the dentition be assessed. And tonight a step forward had been demonstrated in the estimation of muscle behaviour. Mr. Tulley was to be congratulated for being the first to apply electromyography to the study of the highly complex action of swallowing and for presenting his initial investigations in a lucid manner. Electromyography provided a qualitative and quantitative analysis within a framework of time. It was a great advance upon the evidence that the best of clinicians could obtain from their own eyes, though it was fair to say that the correlation of these recordings with models and profile X-rays had done nothing yet to contradict the clinical findings of the moulding effect of muscular behaviour upon the dento-alveolar structures.

It was interesting to note that Mr. Tulley had demonstrated that atypical behaviour had been improved in certain children. He had not shown a case that he would regard as being completely changed from atypical to normal, but they did exist. He himself had watched it happen in both Divisions 1 and 2 of Angle's Class II. He had been looking at three sets of his own models that day where behaviour had become normal, but he could not produce the irrefutable evidence of electromyo-

graphy to prevent anyone saying that his personal observations may have been in error. As these studies with the electromyograph proceeded among a greater number of children and perhaps with the inclusion of other muscles for study, a pointer might be obtained as to which types of behaviour were likely to improve. Clinically, he thought one could often guess correctly that certain grossly poor behaviours would not improve in the end, but there were all too many other cases where a guess was just as likely to be wrong as right.

From the figures obtained from the first forty dental students whom Mr. Tulley investigated, ten were obviously atypical or unspecialised in their behaviour. This was rather more than he would have expected. When he investigated about a hundred children between 7 and 11 years some few years ago he found that about 29% were atypical in their swallowing behaviour and now Mr. Tulley's figures showed that 25% of dental students were atypical. He would have expected a rather smaller figure for young adults, or was it that those with dental irregularities were subconsciously drawn to dentistry.

There was another question which electromyography might be able to answer and perhaps Mr. Tulley already had some evidence. Had he taken two recordings of the same patient with an interval of, say, a week or two between the recordings, and found that the two sets were not identical? Mr. Rix himself did not think that one should assume too early that behaviour during swallowing was utterly constant, taking the short view. Give him a bad cold on top of a week's heavy work and one might find that his tracings would show a change on Friday night. Human behaviour

was likely to be more labile than the behaviour of a Rolls Royce.

Another line which would be worth pursuing was the making of recordings of the parents of subjects being investigated. He expected Mr. Tulley already had this in mind. Electromyography was likely to provide more accurate information than any other method for appraising the inheritance of behaviour. He hoped anyway that Mr. Tulley would endure with this work until the dental students in the fulness of time presented him with their progeny for investigation. This brought up the importance of keeping and preserving a proper filing system which could be used many years hence.

Then there seemed to be another extension that would be worthwhile. Up to the present these investigations had centred around muscular behaviour which on the face of it had a moulding effect upon the dento-alveolar structures in particular. He would like to see another muscle added to the list even though it were rather more remote from the teeth. There was a large one available to a surface electrode which was activated during swallowing. He was thinking of the platysma. It was a very broad sheet arising below from the fascia covering the pectoralis major and the deltoid muscles. In a thin subject one could see the skin of the chest down as low as the summary line being tugged upwards in the act of swallowing. This muscle swept upwards over the clavicles to be inserted partly into the mandible below the oblique line and into the symphysis, and partly into the subcutaneous tissues of the lower part of the face, into the orbicularis oris and zygomaticus, and other muscles about the mouth. Taken with its attachments it formed a broad apron of muscle stretching from the surface of the maxilla and the malar bones right down to the chest wall. Its activity must bring stresses to bear upon the mandible, and they might be of interest to the orthodontist. He thought one ought to know

whether these stresses were altered in those people who did not keep the tongue within the dental arches and did not strap the mandible tightly to the maxilla during swallowing.

Then he would like to ask Mr. Tulley whether he had yet cajoled a dental student into accepting needle electrodes after surface electrode recordings, and if so, were the readings markedly different.

Finally, he would like to thank Mr. Tulley for his interesting paper, and hoped that he would follow this with a progress report in the not too distant future.

Mr. E. GWYNNE-EVANS said that once again he would like to say how much he appreciated coming to the meetings. He thought that Mr. Tulley's application of electromyography to the problem of analysing the various patterns of oro-facial behaviour in swallowing would prove to be a useful contribution to the present knowledge of what correlation there may be between the recurring muscle forces within and around the oral cavity and the form of the dental arches or the alignment of the teeth. For his part, he had recorded his observations of oro-facial behaviour on slow motion cinefilms, but his studies would hardly be complete without the results of electromyographic analysis as used by Tulley, and probably also without the findings of cineradiographic methods of analysis as used by Ardran and Kemp at Oxford, as well as the results of Anderson's investigations.

He had referred to the "visceral" nature of many atypical characteristics of oro-facial behaviour, in the discussion following the recent paper given to the Society by Mr. Rix. As members knew, he had made film records of the rhythmic "pump and squirt" action of the infant's tongue in suckling. This activity was automatic and entirely visceral in nature. There was no controlled or selective action of individual muscles; they were combined to work as a group, independent of voluntary control.

It had been noted that the infant tongue had a broad anterior margin and that it remained confined within the mouth in suckling. A tip developed later; then, between three or four months of age, the tongue became more mobile, so that it could be protruded at frequent intervals and swept round the lips, at first in aimless fashion. Later, the tongue developed purposeful movements and the lips were used to assist the movements of the tongue in receiving food. Once the food was within the oral cavity, however, *all* the oro-facial muscles were fully occupied automatically. The tongue passed the food from side to side between the developing alveolar borders for mastication whilst the lips, and particularly the lower lip, together with the cheeks, were actively employed as an entire group—not as individual muscles—to hold the food in the mouth and also to restrain the spread of the tongue when it was compressed against the hard palate from before backwards by the peristaltic action of the tongue and mylohyoid muscles in the act of swallowing.

The actual transference of food from the oral cavity to the pharynx, whether in suckling or sucking or in the swallowing of liquids or semi-soft food, was brought about by peristaltic activity, a purely visceral function of the oral muscles.

Up till now, the oro-facial muscles had behaved reflexly in response to the normally expected stimuli connected with feeding. Gradually, however, cortical control came increasingly into play and further inhibited the mass or total behaviour of the oro-facial muscles in favour of selected movements, and the child learnt with the help of dutiful and adoring parents, how to eat according to the manner of accepted society—right up to the point of swallowing, which, once initiated, remained a reflex process beyond the cleverest to control.

Thanks to Mr. Rix's observations, it was seen that some children with a fully erupted

dentition brought their teeth firmly together in the act of swallowing, thus anchoring the mandible to give the mylohyoid muscles, in particular, firm points of origin from which they could act in support of the peristaltic wave in the tongue as it passed food backwards towards the pharynx; the muscular walls of the oral cavity were replaced by the rigid boundaries of the teeth in occlusion and the tongue was spread against the hard palate and upper dental arch, whilst the lips and cheeks took little or no active share in the swallowing process.

There were, however, many children who did not bring their teeth together in the act of swallowing. It was known that the mylohyoid could function effectively without anchoring the mandible in suckling and in these children it appeared that once the reflex act of swallowing was invoked, the oro-facial muscles behaved as a whole as they did in earlier life before the dentition was fully erupted and the teeth had come into proper occlusion. In the first phase of the peristaltic wave in the tongue, there was often a powerful forward thrust of the tip of the tongue against the incisive papilla and upper incisor teeth or between the teeth when it was met by a contraction of the orbicularis oris and the attendant muscles, the mentalis and zygomatic groups in particular. The "automatic" or "visceral" nature of the circumoral activity was suggested by the peristaltic form of contraction that had been revealed by slow motion cine studies and was further borne out by the clinical fact that the contraction of the lips was automatic, effortless and often very strong.

It seemed, therefore, that many children with fully erupted dentitions did not exhibit the expected selective action of the oral muscles which allowed the contraction of the masseter and temporal muscles to bring the teeth firmly together in the act of swallowing whilst the lips and cheeks were left in a relatively impassive state.

There were then, these two broad groups of swallowers—the one that may be called the “somatic” type where there was evidence of selective action among the oral muscles in swallowing; the other, the “visceral” type where there was no obvious selective action but a general peristaltic form of behaviour among the oro-facial muscles as a whole. There were many intermediate types between the two groups and variations of the latter group. Some accentuated the contraction of the lower lip, which often slipped under the upper incisor teeth, some had a sharp forward and upward thrust of the tongue against the upper incisor teeth, some showed simply a circumoral contraction with a mechanical spread of the tongue forwards and laterally between the teeth etc.

There were, of course, children who did retain unusually late infantile patterns of behaviour associated with suckling. These could be corrected as a rule and they might have little or no influence on the dentition unless they persisted unduly or were accompanied by the atypical or “visceral” patterns of oro-facial behaviour in feeding and swallowing that had just been described. These latter patterns were regarded as evidence of an atypical or abnormal gradient of development which might persist into adult life. How far they might be modified was not yet known but he personally remained optimistic. It must, however, not be forgotten that the muscular design of the face might be at fault, due perhaps to variations in the shape or strength of individual muscles. That facial muscles possess familial or racial characteristics was undoubted. Some elements, therefore, either in their structure or in their behaviour, might be impossible to eradicate.

In conclusion, Mr. Gwynne-Evans said he hoped that Mr. Tulley would continue with his promising electromyographic studies of oro-facial behaviour and contribute further to this difficult problem of

correlating muscle forces with dental alignment and arch relationship.

Mr. K. E. PRINGLE suggested that Mr. Tulley should look again at one of the students whose case he had shown, he had the impression that that student had been “cheating.”

He would like to describe Class II, Division 2, as he found it in himself. He swallowed with his teeth together. It was not impossible—in fact, it was quite easy—to swallow with the teeth apart. Other points which he had noticed were the lack of lateral movements of the lower jaw, held as it was by the cusps of the check teeth and the closeness of the bite anteriorly. There was a tendency to bolt the food rather than to chew it.

He would ask Mr. Tulley to look very carefully at his close bite cases before he drew conclusions from them finally. It might well be that Mr. Tulley was right in what he had said about them, but personally he felt a little doubtful, in view of what he found in himself.

Miss L. M. CLINCH congratulated Mr. Tulley on his very interesting and original communication.

The point that struck her most in all the work that had been done on swallowing, normal and atypical, was that there did not always seem to be a very great difference in the occlusion of the patients. She thought that the most abnormal-looking child when swallowing that Mr. Tulley had shown in his film was the one for whom no treatment was necessary. She supposed that Mr. Tulley was much too wise to draw any conclusions on the question whether atypical swallows produced any definite malocclusion, but she would like to know whether the cases which he had examined showed any correlation between atypical swallows and malocclusion or whether there was just the same degree of malocclusion when the swallow was normal.

Mr. R. E. RIX, replying to Miss Clinch, said that among atypical swallowers he

had found 81 per cent. of malocclusion and among normal swallowers 36 per cent.

Mr. H. G. WATKIN said he thought that Mr. Tulley's paper was a very interesting and important one.

Mr. Tulley had not referred to the question of giving the patient swallowing exercises in order to correct the tongue and teach the patient to swallow normally. He himself gave his patients swallowing exercises with gratifying results. He thought that Mr. Tulley's instrument might be very useful to ascertain whether there was any improvement in the muscles as a result of these exercises.

Mr. C. F. BALLARD congratulated Mr. Tulley on his paper and said that his own observations led him to believe that in the swallowing action the mandible had to be fixed, and, where Mr. Tulley found that the masseter muscle was not used to fix the mandible, he would have liked him to try the temporalis muscle, particularly the vertical part of the muscle. He thought that some individuals fixed the mandible not so much by the masseter as by the vertical part of the temporalis muscle.

Mr. J. H. HOVELL asked whether Mr. Tulley thought that during swallowing the mandible was brought into active opposition to the maxilla; in other words, that there was pressure on the teeth during swallowing. He himself did not think that that was the case. He thought that the establishment of the centric occlusal position of the teeth was brought about by the mechanism of swallowing. It was at that point, at which there was no pressure, that the centric occlusal position was brought about. He thought that when pressure was present on swallowing, as with a forward bite of accommodation, there was an excessive freeway space, owing to the fact that the muscles were stretched, altering the position of the jaw at the time of muscular relaxation and therefore bringing the mandible higher up. The mandible, he thought, was fixed by the contraction of the elevator and the

depressor muscles. Was not it possible that the alternation in contraction between the muscles around the mouth and the masseter indicated that actually the former muscles were helping to fix the mandible as well as helping to resist the thrust of the tongue? They were helping to fix the mandible, and that partly accounted for the reduction of the action potential of the masseter during swallowing.

Mr. E. K. BREAKSPEAR congratulated Mr. Tulley on his paper.

With regard to the first case which Mr. Tulley had shown, which was one in which the muscle habits had been changed by the patient's efforts, he would like to know what the occlusion had been before and whether it had changed, and, if so, how, during the period when the muscle habits were changed.

In the second case shown by Mr. Tulley the teeth had been put right by an appliance and the muscle habit had improved, and Mr. Tulley had said that he thought that would be stable, in spite of the fact that the swallow was still not completely right. That struck him as a ray of hope, and he would like to ask whether at the time when the second film was taken the patient had been wearing the appliance or whether the film had been taken after the appliance had been left off altogether.

He had been particularly interested to notice that at least half Mr. Tulley's very wrong swallowers had close bites, and he would like to know whether Mr. Tulley had noticed any difference in the recording between the people who had close bites and those who had open bites.

Mr. H. L. LEECH said he would like to thank Mr. Tulley for his very valuable paper.

In opening the discussion, Mr. Rix had mentioned that he had recently had several cases of atypical swallow which had improved, but he had not said whether they had improved with treatment or otherwise. If they had improved with treatment, he

would like to know what sort of treatment Mr. Rix had carried out, whether it was by means of swallowing exercises or whether any appliance had been employed.

Mr. R. E. RIX said that the three cases to which he had referred had had no particular treatment for their muscular behaviour. He had just put the teeth into what he considered to be the best position and relationship, and the rest had followed.

The PRESIDENT said that Mr. Rix had mentioned the platysma and Rogers had had a definite exercise for that.

Mr. R. E. RIX said he did not know of that. Two of the cases were Class II, Division 1. One of them had an open bite as well, not associated with thumb-sucking. Both had monoblocs and both got better extremely quickly, in only a third of the time which he had estimated for treatment.

Mrs. M. MICHAELIS said that she had used Rogers' exercises for a good many years, but she was now quite convinced that those cases which had improved with Rogers' exercises—some of them had made a very marked improvement—would have improved just the same without the exercises.

Mr. B. C. LEIGHTON congratulated Mr. Tulley on his paper and asked whether he had used the electrodes on only one side of the patient. If he had used them on the other side at all, had there been any difference?

Mr. P. J. HOLLOWAY asked whether Mr. Tulley had made any recordings of the activity of the buccinator and whether he thought it was possible to adapt the method to record the activity of the tongue.

Mr. P. READINGS, referring to the fixation of the mandible in relation to the swallow and the action potential that might be obtained from the masseter and the temporalis muscle, asked whether the atypical swallow was a result of the fixation of the mandible not in the closed bite position but partly open, and whether what was called the normal occlusion of the teeth together was necessarily the only

normal. Would Mr. Tulley say that both were normal but that they were two different types? He was referring to the action potential showing the use of the masseter muscle as holding the mandible in a partly open position, a fixed position but not necessarily a wrong position.

Mr. W. J. TULLEY, in replying to the discussion, thanked Mr. Rix for his very kind remarks and for the pertinent suggestions which he had made about future work.

With regard to the high percentage of malocclusion found in the group of dental students that he had investigated, the cases had not been in any way selected. It had just happened that in the group there had been a large number of dental students with quite gross malocclusion.

As to Mr. Rix's suggestion that the tracings should be repeated at intervals, that had been done in the case of one or two students when very inconclusive results had been obtained, but unfortunately he had not had the recording apparatus at that time and he had found variations in some of the cases.

He had not used the electrodes on the platysma. He had used them on the temporalis and the mylohyoid in conjunction with the other muscles, and he thought that with the platysma there would be a pick-up from the underlying muscles.

He had not used the needle electrode at all yet. He hoped that one day he would find a student with a "thick skin" who would allow him to do so.

He would like to thank Mr. Gwynne-Evans for his remarks and to say how much he had enjoyed working with him on the problems in question during the last four years. The subject was very much in its infancy still, and his reason for dealing with it in the present paper was to have the investigation criticised before he proceeded any further with it.

He agreed with Mr. Pringle that in the film the student to whom Mr. Pringle referred had been over emphasizing the

activity. He had been one of the original students and he had been electromyographed before he came to the Orthodontic Department, but the film had been taken after that merely to illustrate the gross pattern. He had tried to get students completely ignorant of the requirements in the recordings, and he had brought with him some of the reels of actual recordings which anyone who was interested could see. He agreed that it was necessary to be very careful and to repeat the test several times, because if the students knew what was wanted they would produce it.

With regard to Mr. Pringle's own swallowing, he did not wish at the present time to emphasise the relationship of deep overbite to atypical behaviour. He had just mentioned it in passing.

Mr. Pringle had said that the type of patient in question bolted his food. He had got chewing and swallowing recordings which showed that that was the case. There was a sort of peristaltic activity with the lips and the masseter and all the other muscles surrounding the mouth contributing to hold the mandible, but there was not quite the same kick from the masseter which was obtained on the tracings in the classical type of swallowing behaviour.

With regard to Miss Clinch's remarks, the patient in the first case that he had shown was somewhat of an enigma. In a provocative frame of mind he had included this case in a paper to the European Orthodontic Society on the aetiology of malocclusion. She had a quite marked proclination of the upper incisors, which he thought was unattractive in a young lady. He had not treated her because she had not come because she was worrying very much about her teeth. She had acquired a lip seal, but he would not say that she had trained herself to swallow; he thought it had just happened that the pattern had been modified.

In reply to Mr. Watkin, he would say that he did not believe that patients could

be trained to swallow correctly. Their swallowing was a basic behaviour pattern, going on all the time; it was in the unconscious levels of the mind and was not a matter of conscious effort. One could train patients to swallow correctly all the time one was with them and they might do their exercises very carefully every evening, but he did not believe that the pattern could be basically altered in that way.

He had tried using the electrodes in the temporalis and had got the same pattern. There had been a contraction of the temporalis in the teeth-together swallow but very little activity in the teeth-apart swallow. Coupling this with what Mr. Hovell had said, he still felt that the teeth-apart swallow was a very slovenly swallow, and he thought that the force used could be measured only by Mr. Anderson's type of apparatus. His own apparatus would show muscle activity, but it was necessary to have a very complicated apparatus to evaluate the force used. He still felt that the masseter was contributing somewhat; there was activity in the masseter at the moment of swallowing, there was the elastic bulk of the tongue between the teeth, and there was the bolting of the food.

With regard to Mr. Breakspear's remarks, he did not think that in the first case which he had shown the patient had changed the behaviour by her own efforts. He did not know how it had been modified, but it had not been modified very much. She could produce a normal swallow, but he felt that the basic behaviour was still there.

In the second case which he had shown, the monobloc had not been worn at the moment of recording but the patient had still been having treatment with the monobloc. He thought that this type of recording would be of value in assessing the results of treatment with the monobloc.

He was not prepared at the moment to say anything about the overbite in relation to the atypical swallow, as he had not sufficient evidence on the subject.

He agreed with Mrs. Michaelis that most of the swallowing patterns that changed with exercises would have done so in any event.

In reply to Mr. Leighton, the electrode had been used on both sides and very similar patterns had been obtained.

With regard to Mr. Holloway's questions, he had not put the electrode on the buccinator itself, but, in putting the electrode on the circum-oral muscles, he was taking up some fibres of the buccinator at a deeper level than the superficial strata. He did not see how it would be possible to take recordings on the tongue.

He had already partly answered Mr. Readings' question about the difference

between the anchoring of the jaw in the two cases. There was a considerable variation. Some people occluded their teeth with a good deal of force.

He was grateful to all those who had taken part in the discussion. Their remarks would enable him to put the research on to more scientific lines and try to overcome all the factors which might be tending to produce an artificial result.

The PRESIDENT, in proposing a vote of thanks to Mr. Tulley for his very interesting paper and the excellent films which he had shown, and to Mr. Rix for opening the discussion, said that the members would look forward to having another paper from Mr. Tulley when he had proceeded further with his experiments.

Retraction of Maxillary Teeth with Removable Appliances Using Inter-maxillary Traction or Extra-oral Traction

S. G. McCALLIN, L.D.S., R.C.S.

AN ATTEMPT will be made to describe two techniques which have proved to be valuable for the application of traction with removable appliances. Without attempting to discuss the diagnosis which led us to apply traction in either of the cases to be shown, it is hoped that you may be

interested to see the type of tooth movements that are possible with relatively simple appliances if the following techniques are used.

The first case is a fourteen year old patient with a Class II, Division I malocclusion, where the lower labial segment

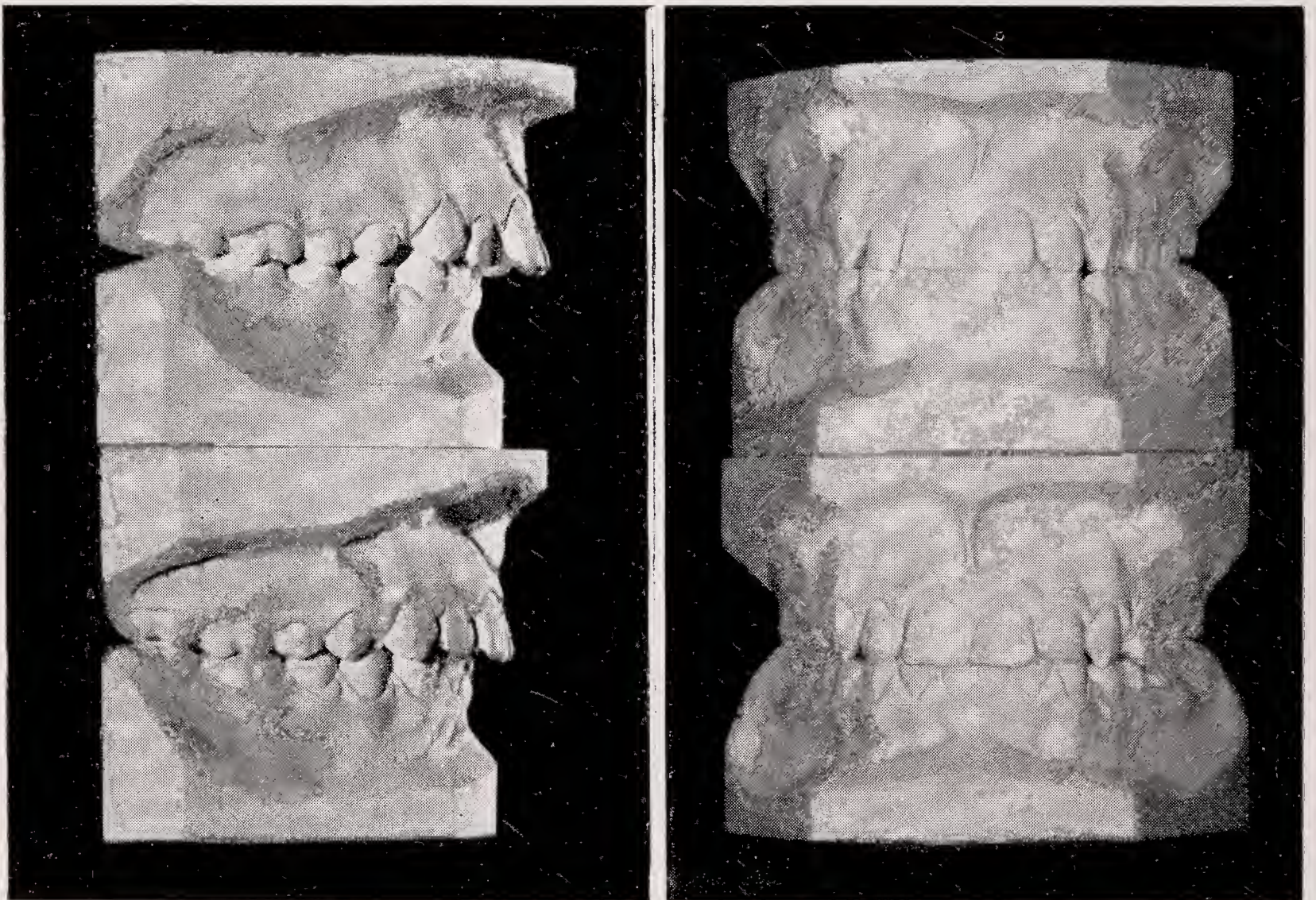


FIGURE 1
Top models A; lower models B

Given at the meeting of 14th December 1953

was slightly separated from the lower buccal segments (*Fig. 1A*). The upper incisors were proclinated with the upper buccal segments forward. The dental base relationship was Skeletal II. Our diagnosis led us to decide to attempt to retract the upper buccal segments followed by a retraction of the upper incisors against the closing up of the spacing in the lower arch. Not only was spacing present in the lower arch, but our assessment of the muscle behaviour pattern led us to believe that a mild proclination of the lower labial segment would be permissible. In fact this is the ideal type of case in which to apply Class II inter-maxillary traction. Removable appliances were constructed and I should like to make one or two general points about them.

In the upper the appliance was retained with Adams' clasps (*Fig. 2A*). (The labial bow was not used during the first four months of treatment.) You will notice the coffin spring in the palate which is activated very slightly to permit the upper buccal segments to move fractionally

buccally as they go distally. This is necessary if the upper buccal segments are not to move lingual to the lowers as they go back. One can use an expansion screw for this purpose, but by using a spring you take the onus of screw turning away from the patient, and it is easier for the patient to seat the appliance properly than it is when he has just turned the screw. It is also far less bulky.

The lower appliance is more or less self-explanatory (*Fig. 2B*). The only points I would like to bring to your notice are: First, a hook is bent into the clasp round the lower first molar; secondly, the appliance is held firmly down anteriorly by clasps on the first premolars, and thirdly, that the labial bow is constructed so that it passes across the labial surface of the lower incisors as near the incisal edges as possible to prevent a labial tipping of these teeth, and it must also be carried back far enough to contact the labial surface of the canines. In this way the lower arch is braced as a unit and affords probably the most stable anchorage that can be

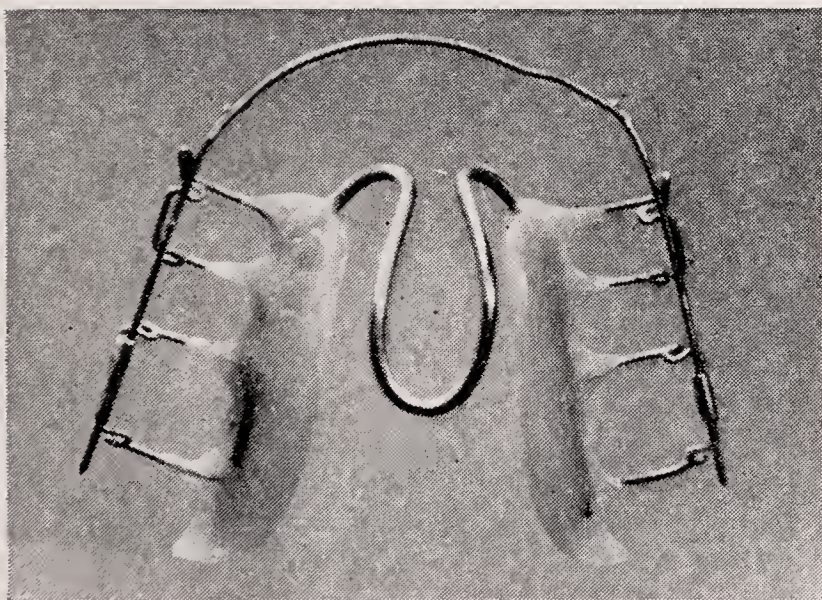


FIGURE 2 A

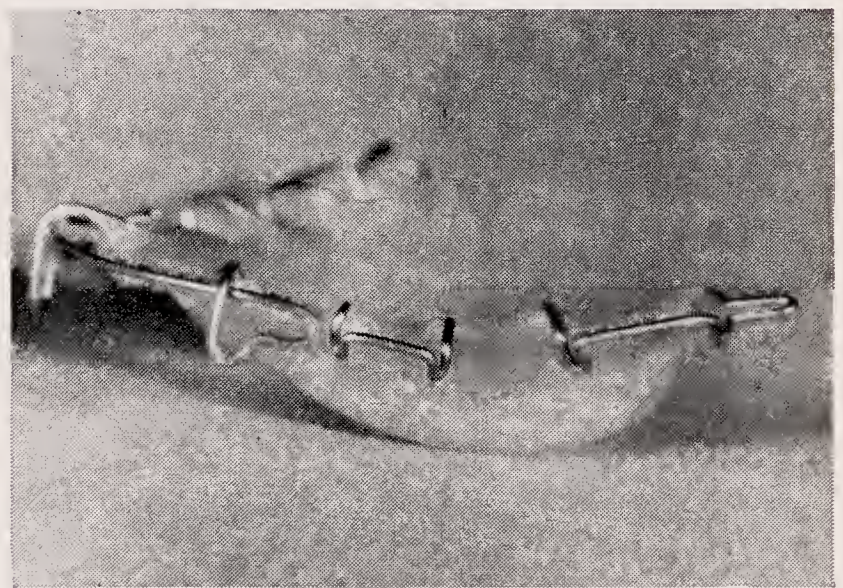


FIGURE 2 B



FIGURE 2 C

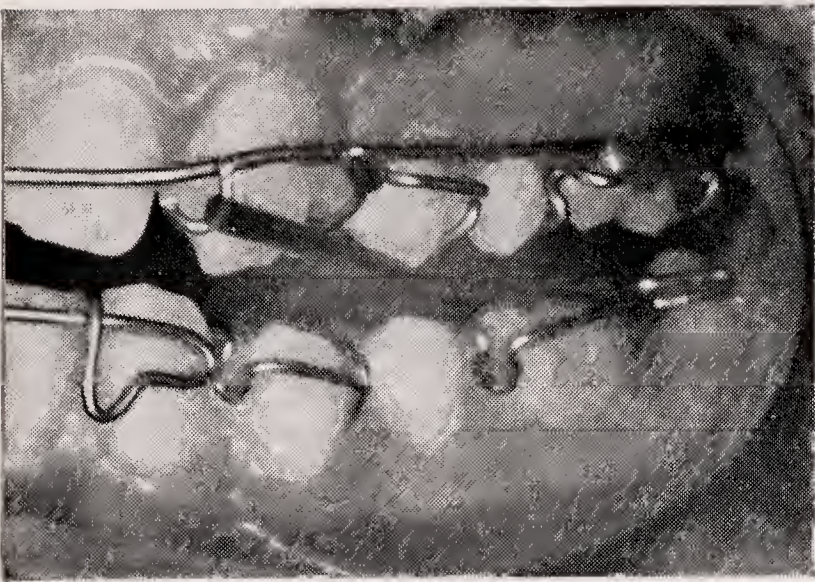


FIGURE 2 D



FIGURE 2 E

obtained with a removable appliance. Even if there is no spacing in the lower arch, as in this case, this appliance has proved itself to be effective to resist a mesial drift of the lower dentition in response to inter-maxillary traction (Class II type).

These appliances were worn for four months, by which time the upper buccal segments had gone back appreciably, and spaces distal to the canines were opening up.

At this point 1 mm. tubes were soldered onto the clasps round the upper first molars. (*Figs. 2C, D, E*). It is useful to retain the model upon which the appliance was processed to help one to align these tubes correctly. A labial arch in .9 mm. stainless steel wire was then prepared, which slid freely in these tubes and was in contact with the upper incisors, to which was added traction hooks in the canine region. Inter-maxillary traction rubbers were then hooked up from these hooks to the posterior hooks on the lower appliance and through the upper labial arch which was free sliding in the tubes, the upper incisors were retracted. No special arrangements were made to retract the canines, they simply dropped back with the labial segment.

Fig. 1B shows the condition after eleven months treatment. You will see that treatment is not complete, this short communication being mainly concerned

with methods for moving upper buccal segments distally.

Sometimes it is necessary to depress the lower incisors in order to facilitate the retraction of the upper labial segment. If this looks like being necessary one can do it either at the outset of treatment with a bite plate, or wait until the retraction of the upper incisors seems to be held up by the over-eruption of the lowers, in which case a bite plate has to be worn before proceeding with the treatment. It is not easy to generalize on this point and each case must be treated on its merits.

These cases can often be retained without modifying these appliances, except that the arch should be firmly fixed in the tubing and the rubber traction gradually discontinued. If a muscle abnormality is present that normally responds to the wearing of an Andresen appliance this can be used for retention, and a tongue thrust that goes with incompetent lips can sometimes be controlled by the wearing of such an appliance.

In the second case (*Fig. 3*) the patient was twenty-two years of age, with a normal dental base relationship. In the upper arch the upper buccal segments were one pre-molar unit mesial to the teeth in the lower buccal segments and the maxillary canines were impacted labially and tilted mesially. The apices of these teeth were well back in a favourable position for

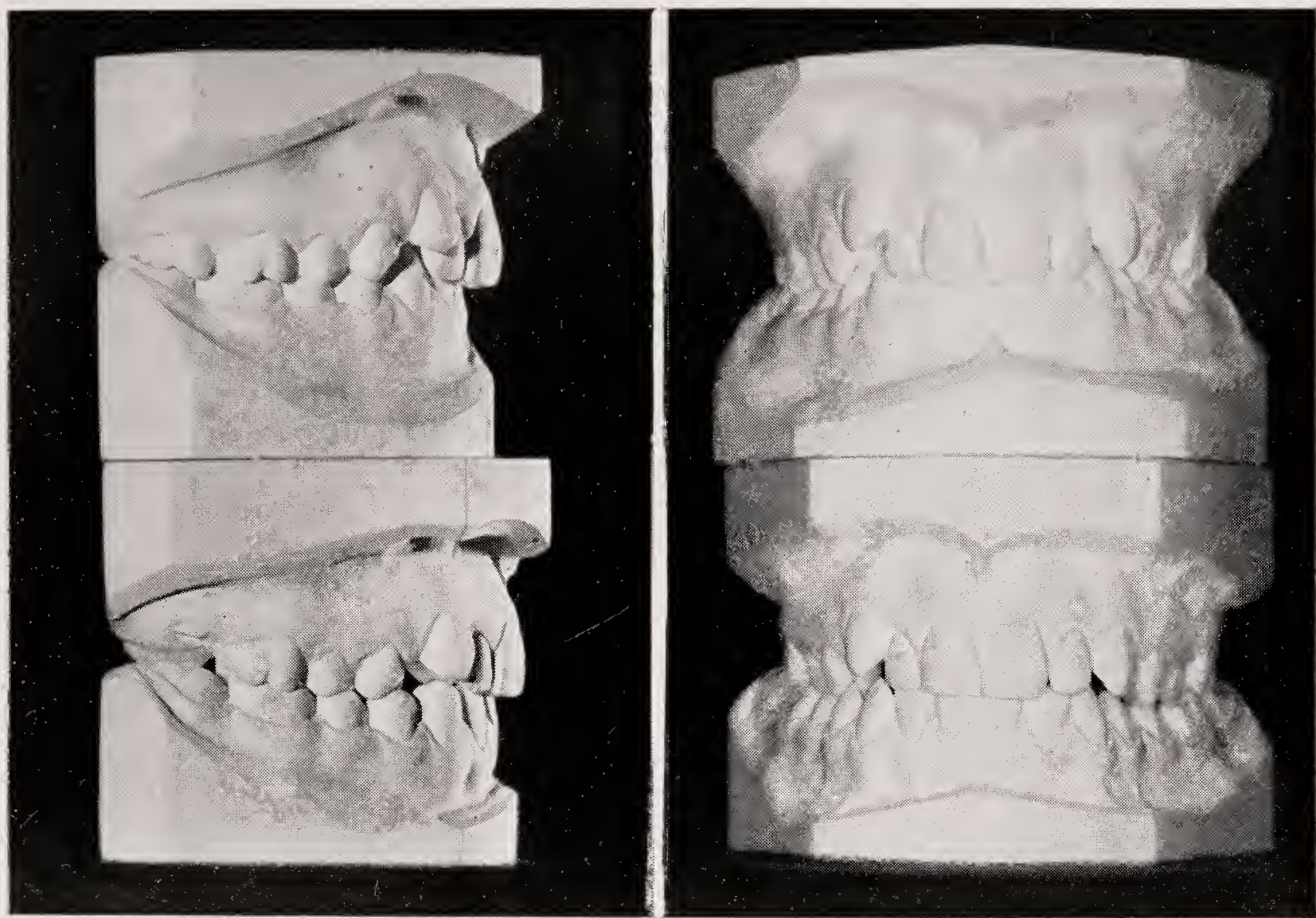


FIGURE 3
Top models A; lower models B

their retraction. It was decided to extract the upper second molars the upper third molars being present, and to retract the upper buccal segments to make room for the canines. One reason which led us to do this rather than to extract the upper first pre-molars was that the apices of the pre-molar teeth were far enough back to allow us to tip the canines distally. Our assessment of the soft tissue behaviour indicated that it would be a waste of time to procline the upper incisors and attempt to bring the mandibular dento-alveolar structure forward in order to obtain normal buccal occlusion. In view of this it was decided to use extra-oral traction as our main force to retract the upper buccal segments, and removable appliances were constructed as follows.

You will see in Figs. 4A and B, that appliances were made similar to those used in the previous case, but here the tubing was added to the clasps on the

upper first pre-molars and not the molars. The lower appliance was similar to that shown in the previous case. These appliances were inserted after the extraction of the upper second molars, and extremely light Class II inter-maxillary traction was applied. Then, after two weeks of this, a .9 mm. labial bow was constructed to fit into the tubes and stopped mesial to them with sliding coils of .4 mm. wire, which had previously been twisted up on a .8 mm. core. These were then forced under pressure onto the .9 mm. labial bow so that they acted as friction stops that were adjustable. 1.25 mm. wire was then soldered in the mid-line and bent to pass out of the mouth in such a way that it lay flush against the cheeks (Fig. 4c). The labial bow, on being inserted into the tubes, was adjusted so that it stood slightly labial to the upper incisors. The inter-maxillary traction was discontinued after two weeks, and the upper

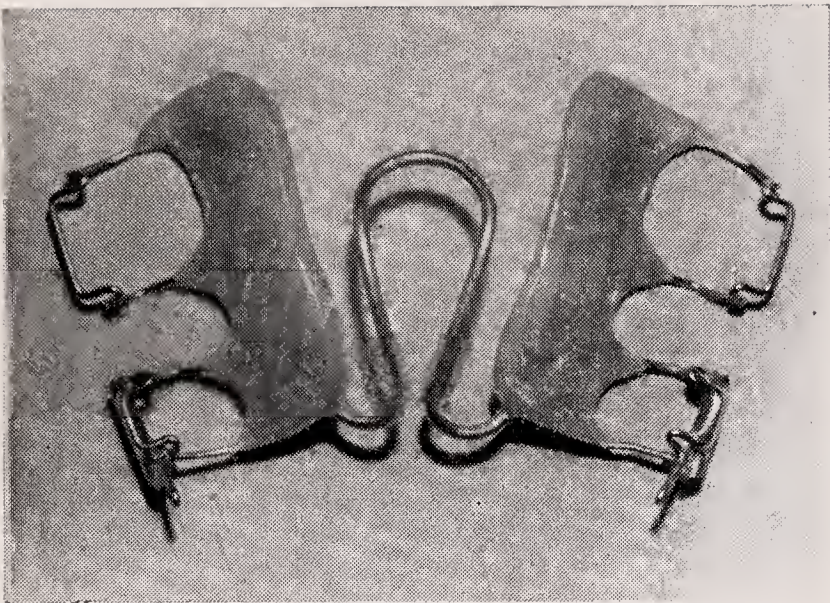


FIGURE 4 A

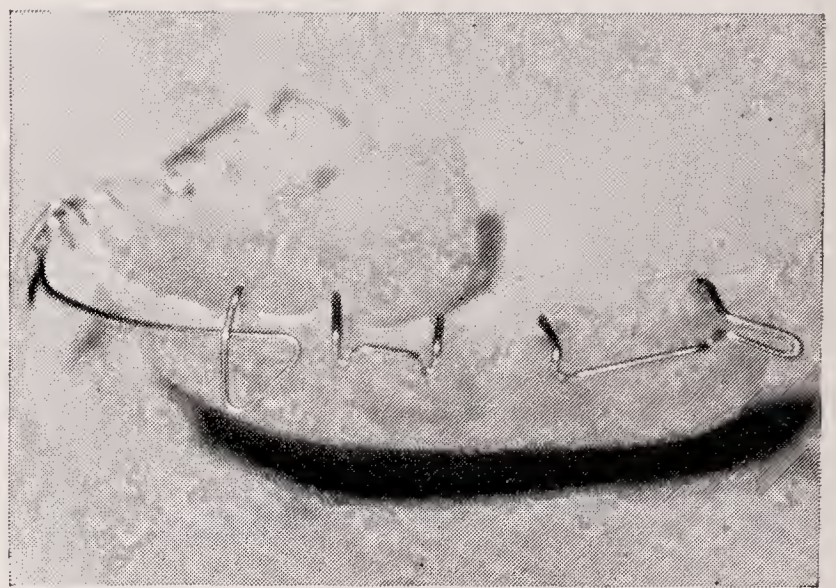


FIGURE 4 B

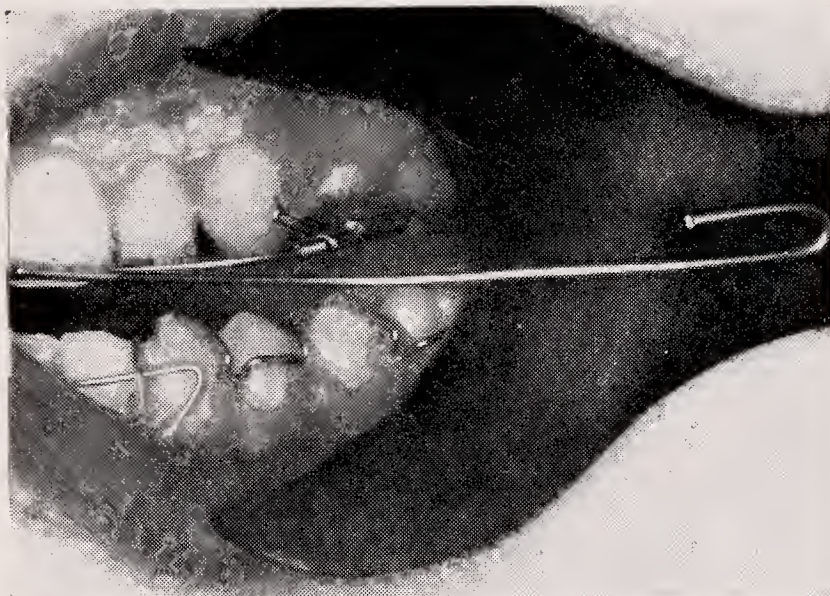


FIGURE 4 C

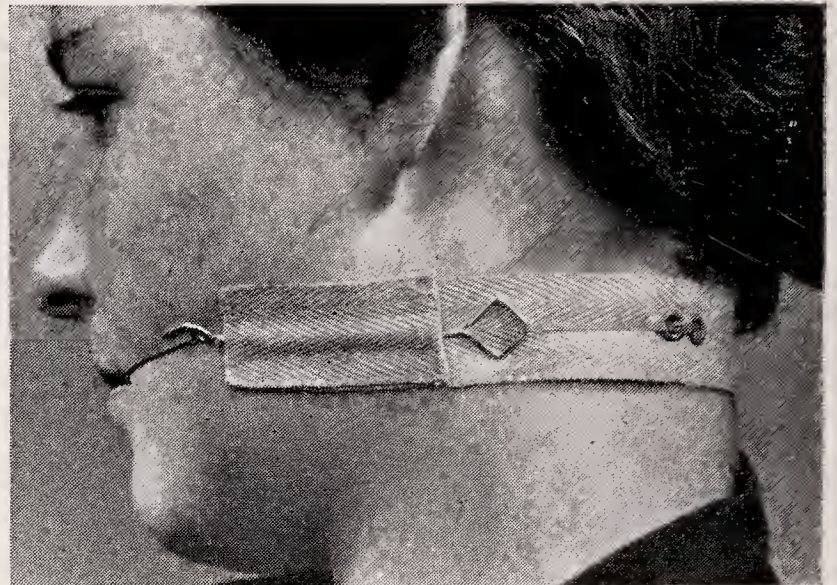


FIGURE 4 D

appliance was placed on cervical traction as shown in Fig. 4D.

This cervical harness was first shown to me by Endicott, since when it has been found to give less trouble than any other form of extra-oral anchorage. The webbing strap can be pre-fabricated thus avoiding tailoring the harness to the head. It lies flat against the patient and it is washable.

There are other forms of extra-oral head gears and harness shown in Fig. 5, which can all be used with these appliances. Fig. 5A is an illustration of the cervical apparatus shown by Hill at our last demonstration meeting, and I have found that it provides an exceedingly efficient pull. It is, however, a little more bulky and it is rather more difficult to obtain

the Duramin tubing and the sorbo rubber in the right size than it is to buy a strip of webbing.

While we are on this subject, Fig. 5B illustrates the traditional head-cap and it has one advantage in that the hook at the distal end of the rubber can be sited so that the pull on the labial arch can be directed upwards if necessary. It is, however, more difficult to make and when washed it shrinks.

Fig. 5C shows a very simple arrangement made up with Thermo sealing plastic belting, where all the pieces can be joined by passing a hot knife between the surfaces of the plastic, and the hook is simply sunk into the plastic hot, when it will hold quite satisfactorily. The only difficulty with this is that it is rather difficult to



FIGURE 5 A



FIGURE 5 B



FIGURE 5 C

obtain material of this kind that does not produce a reaction on the skin of the face.

Now to return to our case. The patient wore routine inter-maxillary traction for about six weeks, then the labial bow was inserted and after five months you will see that there has been a marked retraction of the upper buccal segments (Fig. 3B), and there is adequate space for the canines to be brought into favourable alignment.

SUMMARY

Methods for using Class II inter-maxillary traction and extra-oral traction to obtain distal movement of the upper buccal segments have been shown. It is not suggested that these methods supersede the more conventional types of appliance

therapy that can be used to bring about similar tooth movements. In these days when many of us are called upon to carry out orthodontic treatment in general practice, methods such as these requiring little chairside time probably have a place, and in selected cases we can hope for considerable benefit to our patients. Modification of the Schwartz arrow-head clasp as demonstrated by Adams, has made the firm anchorage of these traction appliances possible and, indeed, they will only function as required if they are firmly retained in the arches.

I am indebted to the Photographic Department of the Eastman Dental Hospital for the illustrations.

DISCUSSION

The PRESIDENT thanked Mr. McCallin for his interesting communication and said it was very pleasant sometimes to see old things coming back. The Coffin spring, to which Mr. McCallin had referred, had been the only appliance used for expansion many years ago.

Mr. N. C. TA'BOIS asked whether the appliances were worn continually or at night only.

With regard to the question of opening the bite if the lower incisor were impinging on the uppers, what was the effect, after the uppers had been retracted, when the appliance was removed and the bite was allowed to close again?

Mr. J. S. BERESFORD said he would like to thank Mr. McCallin for his very interesting and most instructive communication, from which he had obtained a good many ideas.

He would like to know what was the time interval between the models in the case of the 22-year-old patient.

He would also like to ask what gauge wire Mr. McCallin liked for the Coffin spring, what gauge wire he liked for the extra-oral wire, and what method he favoured for attaching the extra-oral wire to the labial bow on the appliance.

Mr. R. E. RIX said he would like to thank Mr. McCallin for a very interesting and, as Mr. Beresford had said, most instructive paper.

There was one little snag that he had seen resulting from the extraction of upper 7's, in an endeavour to move back the buccal segments, namely, that it had permitted the lower 7 to rise, and to rise to such an extent that the upper 6 had not been able to move distally far enough to

get a normal antero-posterior relationship between the 6, 5 and 4. In the end that had prevented the perfect alignment of the upper incisors. He would like to know whether Mr. McCallin had found that snag and whether he took any special measures to avoid it.

Mr. COOPER said he thought that the appliance described by Mr. McCallin was one of the best that he had ever seen. He congratulated Mr. McCallin upon the excellent results he had obtained, which had been very well presented to the meeting.

Mr. H. CHAPMAN said he would like to thank Mr. McCallin for his excellent paper.

Was it possible that the lower arch had moved forward in the first case which Mr. McCallin had shown, in which there had been intermaxillary traction?

He would also like to ask what degree of force was exerted by the rubber bands in treatment.

Mr. S. GRANGER MCCALLIN, in replying to the discussion, said that Mr. Ta'Bois had asked whether the appliances were worn all the time or only at night. If they were worn only during the night a very definite response would be obtained but it would take longer to obtain it.

With regard to the question of opening the bite and what happened when the bite-opening appliance was removed, he was not sure that he knew the answer to that. Certainly it was difficult to generalize. Usually the buccal segments went back if one got the second appliance in quickly as the bite remained open long enough. The retraction appliance worked quickly enough in a good patient to get back the

buccal segments and retract the labial segments with them. But was not that a problem with many of the Class I, Division 1 cases? He did not really believe that there was a simple answer to the question.

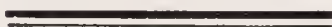
In reply to Mr. Beresford, he used 1.25 mm. wire for the Coffin spring and for the extra-oral wire; it should not be less than that, or it would be pulled against the cheek. The extra-oral wire was attached to the labial bow by taping it round once, welding it and flowing solder under the tape. The length of time in the second case, the extra-oral one, was about five or six months.

Mr. Rix had referred to the point of the eruption of the lower 7 when the upper 7's were extracted. He had known the lower 7 to rise but he thought that the wire of the clasps going across helped to hold the lower 7 down. On many occasions, however, he had deliberately carried a wire distally from the plastic on the lingual side of the appliance and turned it up to rest on the top of the second molar, and thought that should always be done as a good insurance.

Mr. Chapman had asked whether the lower arch had moved forward in the first case that he had shown. It had undoubtedly done so, but there had been some spacing in the buccal segments in that mandibular arch, so that forward movement could be allowed. He did not mind that. Even if the lower incisors came forward a little when the appliance was removed the muscle action took them back.

He had never measured the amount of force which the rubber bands exerted. He did not think there was any point in using very powerful ones; they would simply pull the appliance out of the patient's mouth. It was the constancy of the force rather than the quantity of it which was important.

The PRESIDENT, in moving a vote of thanks to Mr. McCallin for his very interesting and instructive short communication, said he agreed with Mr. Cooper that it had been particularly well presented, and the members were greatly indebted to Mr. McCallin for it.



The Relation of Spacing of the Upper Central Incisors to Abnormal Fraenum Labii and Other Features of the Dento-Facial Complex

C. P. ADAMS, B.D.S., F.D.S.

THE EXISTENCE OF a space between the upper central incisors has for long been recognised as a clinical entity, not only during the developmental stages of the dentition but also sometimes in fully developed dentures.

From the orthodontic point of view, such a space is considered to be an anomaly and in the past a good deal of attention has been given to the condition and various explanations for it have been advanced.

Spacing of the upper central incisors is still very often attributed to the existence of what is termed an "abnormal fraenum labii" and as a rule it is at the same time stated or implied that this factor is the sole cause of the diastema. Sometimes, on the other hand, it is said that the fraenum does not cause spacing of the central incisors and that in fact the space is caused by certain other factors. Yet another explanation is that spacing of the incisors is a feature of certain dentitions and that the enlarged fraenum is simply associated with spacing of the incisors, there being no cause-and-effect relation between the two.

It would appear that because of the present lack of agreement on the question of the relation between the fraenum and spacing of the upper central incisors, some review of the subject and an effort to reconcile the conflicting opinions might not be out of place.

The standard works on dental surgery and orthodontics do not treat the subject exhaustively. Angle (1907) stated many years ago that "the cause of the deformity is abnormal development and attachment of the *fraenum labium* which instead of being normal in size and ending in its attachment to the gum about five millimetres above the gingiva, not only reaches the gingiva but passes directly between the teeth and is attached to a likewise over-developed mesiolingual tuft. This strong fibrous ligament keeps the teeth separated not only by its passive presence but as well by its action mechanically."

It is interesting to note that this short and categorical explanation is still accepted in its essentials and is still stated and re-stated for the most part as the complete explanation.

According to Bennett (1931) "The fraenum of the upper lip is usually attached to and blends with the gum on the labial side of the teeth, but in a few cases it passes between the central incisors and blends with the gum of the palate. The necessary result is separation, usually accompanied with slight rotation of the central incisors." Bennett also says, however, that "The existence of an abnormal fraenum in cases of separation of the central incisors should not be assumed without careful examination. When the separation is due to other causes, fibrous gum tissue necessarily

intervenes, and may simulate abnormal fraenum. In these cases the incisors often become approximated by natural forces."

Stones (1951) says that "Persistence of the attachment of the fraenum labii to the incisive papilla after eruption of the teeth generally causes separation of the maxillary first incisors."

McCoy (1946) adopts the same view in saying "This condition is usually the result of the abnormal development and attachment of the fraenum labium which owing to its labial attachment and consequent mobility prevents the central incisors from assuming and maintaining their normal approximal relations."

Hemley (1953) suggests that in some cases through the agency of the fraenum a greater deposition of bone takes place in the inter-premaxillary suture than should occur, leading to spacing of the central incisors. In cases in which the inter-premaxillary suture has closed and the fraenum persists, pressure of the fraenum on the teeth causes them to diverge, the apices remaining in relatively normal positions.

Salzmann (1952) does not contribute any original view but in his text includes a digest on the subject from other sources.

Strang (1950) describes the type of fraenum that runs directly from the lip to the incisive papilla and says, "In a great many children this fibrous tissue, particularly in connection with the maxillary arch, becomes elongated at its alveolar end into a sheet-like process that extends lingually between the central incisors, cutting through the interproximal fibres of the periodontal membrane . . . The separating of the fibres of the "ligamentum circulare" and the presence of this foreign tissue prevents the permanent incisors from normally approximating each other, as they erupt, and favours continued spacing of these teeth as the patient grows older. The crowns of the incisors are also often badly deflected as to their axial position by this tissue growth."

The standard texts on orthodontics, therefore, all take a rather similar view of the question of spacing of the upper central incisors and the fraenum labii and see a fairly direct connection between the two.

The dental periodical literature, on the other hand, provides a wealth of material dealing with the subject from many different angles. Some papers are surveys showing the incidence of spacing in relation to age, others discussions on the relation of spacing to the fraenum and other features of the occlusion, yet others are simply descriptions of the best way to remove the fraenum and are, therefore, treatises on oral surgery rather than on orthodontics.

Taylor (1939) examined a large number of children at different ages to determine whether spacing of the central incisors had any relation to age and concluded that:—

Years					
at 6	66	out of 68	(97%)	had diastema	
„ 6-7	29	„ „	33 (88%)	„ „	
„ 10-11	18	„ „	38 (48%)	„ „	
„ 12-18	75	„ „	1068 (7%)	„ „	

He also states that "Out of 75 cases noted it was apparent that a more careful examination would have revealed that many of them were due to causes in no way related to the fraenum," and expressed the belief that "The space may be the result of a number of causes among which are tongue, finger or lip habit, endocrine dysfunction, missing teeth, short upper lip, anterior dental protraction, peg laterals, large mandibular teeth."

Tait (1924) in the summary of his lengthy and detailed paper, among his conclusions states that "The fraenum has no evident function in children and adults, and its action, if any, in relation to the upper central incisors is purely passive, resisting lateral pressure. In this connection the papilla palatina plays an equally important part" and also, "The fraenum is a structure sometimes associated with,

but not the cause of, separated upper central incisors" and again, "spaced central incisors are not an abnormality but a definite type of dentition"

Dewel (1946), in a comprehensive review and discussion, raises some new points. ". . . there is considerable misunderstanding as to just what constitutes the genuine but rare abnormal fraenum as opposed to the harmless though common enlarged variation of the normal fraenum." He also reviews the effects produced by various factors in spacing of the front teeth and in conclusion states, among other things, that "No fraenum should be considered abnormal until every conceivable cause of separation of the central incisors has been eliminated."

To recapitulate the main points of present-day belief on the matter;—

1. Spacing of the upper central incisors is a common feature of the developing dentition but in a high proportion of cases the space later closes up.
2. In cases where spacing of the central incisors persists, this spacing may in certain instances be due to an "abnormal fraenum."
3. The abnormal fraenum must be distinguished from the enlarged but normal fraenum.
4. In some cases, spacing may be due to other factors. The introduction of these factors leads to a confusion that it is hoped this paper will resolve. For instance, such obvious factors as supernumerary teeth in the midline or finger habits are quoted side by side with factors such as endocrine dysfunction or short upper lip and both are imperfectly related to the "abnormal fraenum labii" producing as a result an inextricable tangle of ideas.
5. The way in which the fraenum causes spacing of the teeth if responsible for this is thought to be by its bulk, resisting lateral pressure and by its movements pressing the teeth apart

and leading to bone deposition between the teeth, the crowns then being divergent and the apices in normal position or sometimes close together.

Although recent literature has widened somewhat the study of this particular anomaly of the human dentition, there is still a sense of incompleteness about the many explanations of the relation between the fraenum and spaced central incisors that have been advanced.

There are two reasons for this. First, the early idea of an "abnormal fraenum" as opposed to a "normal fraenum" still pervades the subject. At the same time, the distinction between the "abnormal" and the "normal" fraenum has never been drawn. Secondly, while it has always been allowed that an "abnormal fraenum" may occur in the presence of central incisors that are not spaced, little if anything has been said about central incisors that are spaced in the absence of an "abnormal fraenum."

Dewel has attempted to solve the first problem by postulating the existence of an "abnormal fraenum" to be distinguished from a "normal but enlarged fraenum." But how exactly these two are to be distinguished is not clearly stated. The second problem, that of spacing of the central incisors in the absence of an "abnormal fraenum" never seems to have been fully considered.

The whole trend of opinion hitherto appears to have been inspired by the idea that in certain cases the fraenum actively keeps the central incisors apart. The main purpose of this paper is to suggest that the fraenum by itself has no effect directly in causing spacing of the central incisors but that in certain cases it has a determining effect on spacing of the incisors in conjunction with other factors and that in such cases the fraenum often does not even approximate in appearance to the conventional "abnormal fraenum."

It is suggested that there is, as it were, a

predisposing cause or causes and an exciting cause acting together to produce the spacing, the presence of both factors simultaneously being necessary to produce this effect.

In brief, the predisposing cause is a tendency to spacing among the upper incisors; the exciting cause is the fraenum labii.

The arrangement of the teeth and the occlusion are governed by a number of factors among which are:—

1. The ratio of basal bone size to the amount of tooth substance present.
2. The skeletal pattern.
3. The posture and function of the soft tissues surrounding the dentoalveolar structures.

The operation of these factors in certain instances produces a tendency to spacing of the upper incisors and the ways in which this effect is produced will be discussed.

The ratio of basal bone to the amount of tooth substance present, sometimes known as the tooth-tissue ratio, is variable. In the normal, by which is implied the ideal or perfect human denture, there is a nice balance between the amount of bone in the maxilla and mandible and the size of the teeth. There is just enough room for all the teeth in the jaws and as a result, the dental arch is continuous through the contact points, each tooth being in contact with its two neighbours, except, of course, the third molars.

Now it is thought that, in such an arch, there is a pressure transmitted along the line of the arch through the contact points in a forward direction and that the pressures on either side are transmitted to the centre line and there oppose each other equally. Stabilising effects that prevent collapse and disintegration of the dental arch are thought to come from the pressures of the tongue and lips on the lingual and labial surfaces of the teeth.

Evidence in support of the idea that there is a forward pressure through a continuous

and unbroken arch is to be found in various places. Brash (1926), Friel (1938) and Scott (1948) have given evidence to show that an important factor in the development of the occlusion is the forward migration of the teeth through the alveolar bone. It is also well known that when a tooth is lost from the arch, the teeth behind the gap move forward and those in front fall back, or according to Friel, fail to continue to move forward with the developing dentition.

Black (1924) estimated that with age, the contact points of the teeth wear flat and that in all, in either arch, their wear may amount to ten millimetres. This wear is taken up from behind, and the continuity of the arch maintained.

Finally, it has been suggested by Stallard (1923) that on account of the fact that the temporomandibular joint is above the occlusal plane and that as the cheek teeth as a rule are inclined forward slightly, when the teeth are pressed into occlusion a forward component of the pressure of occlusion results, both in the lower as well as in the upper jaw and that this "anterior component" tends to push the teeth forward along the line of the arch.

It is difficult to demonstrate or prove experimentally that this forward pressure exists. In certain cases, there seems to be strong evidence that it does exist for the reasons mentioned above. There are, however, to be found dentitions in which the tooth-tissue ratio is so favourable that there is more than adequate room for all the teeth and in which there is spacing, generally in the labial segments, and in some cases even in the buccal segments. In such instances the tendency to forward migration appears to exhaust itself before interproximal contact is established and the anterior component of force does not seem to count as a factor in the equilibrium of the denture. The teeth remain in equilibrium in a labiolingual direction between the opposing pressures of the lips and cheeks and the tongue. There does not

appear to be any reason for failure of the spacing to close up from the back of the arches.

Variations of the skeletal pattern do not of themselves produce spacing of the teeth. In those Class II Division I cases in which there is an associated posture of the lower lip beneath and behind the upper incisors and a firm contraction of the lower lip against the lingual surface of these teeth during swallowing, the upper incisors are often proclined and spaced. It is thought that in such cases, the proclination and hence the spacing of the upper incisors is secondary to the skeletal pattern through the medium of the lip posture and function during swallowing. To this extent variation in the skeletal pattern produces spacing of the upper incisors.

There is little doubt that, in certain cases, thrusting of the tongue produces a symmetrical proclination of the upper incisors and a consequent spacing of these teeth. Here again, while there may be some forward movement of buccal segments following proclination of upper incisors and canines, the spacing of the front teeth does not close up completely from behind in many cases, if it closes at all, so that a permanent spacing of the upper front teeth remains.

The fraenum itself is an extremely variable structure from the clinical point of view. It is "left behind" during the early process of formation of the labial vestibule. The fraenum is not a developmental structure in the sense that the various organs are differentiated from the embryonic tissues. In consequence, a term such as "overdevelopment of the fraenum" seems singularly inappropriate for a structure that is a kind of residuum of the process of development of the buccal vestibule as a whole. Most authors state that the fraenum gradually recedes as the alveolar process develops and the teeth erupt. That this does not always occur is shown by the persistence of the

fraenum in certain cases in a large form right up to and during adult life.

Possibly there is a differential growth rate for the fraenum and the alveolar process, in some cases the developing alveolar process outstrips the developing fraenum and in others the fraenum grows as strongly as the alveolar process, retaining its early form, relation and size in proportion to the alveolar process. It may be true to think that these proportions and relations are established at the time of formation of the buccal vestibule and that thereafter the process is only one of overall growth and enlargement so that progressive recession of the fraenum with the passage of time may not in fact take place.

The conventional "abnormal fraenum" associated with diastema of the upper incisors runs from the lip directly between the upper central incisors to the incisive papilla. Usually it is wide and triangular in shape, tension on it produces movement and blanching of the incisive papilla. The incisive papilla is usually large and raised above the level of the palatal rugae. It extends well forward between the cingula of the central incisors and often terminates anteriorly in a small tubercle.

A fraenum and incisive papilla of this kind are usually used to illustrate the "abnormal fraenum" and the diastema between the central incisors that they are said to cause. It is urged by Dewel that such "abnormal fraena" should be distinguished from the "commonly found enlarged but normal fraena" which resemble it but which do not in fact cause diastema. Fig. 1 illustrates the typical "abnormal fraenum" in a patient of eight years of age.

The opposite extreme is the narrow fraenum which runs into the alveolar mucosa well above the cervical margin of the teeth and which usually co-exists with an incisive papilla which is small and which is set well back in the palate from the cingula of the central incisors (Fig. 5).

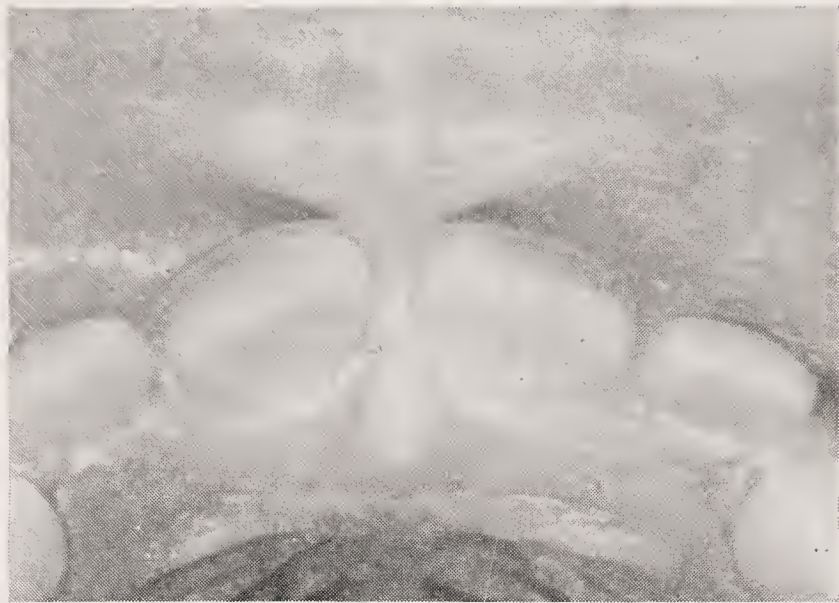


FIGURE 1

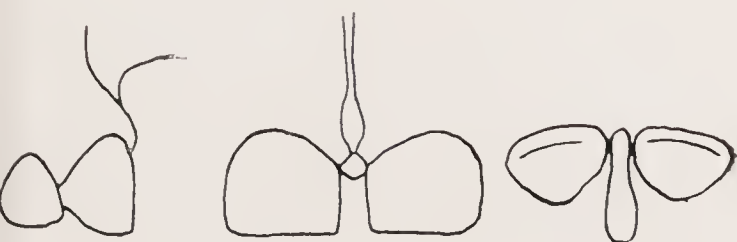


FIGURE 2



FIGURE 3

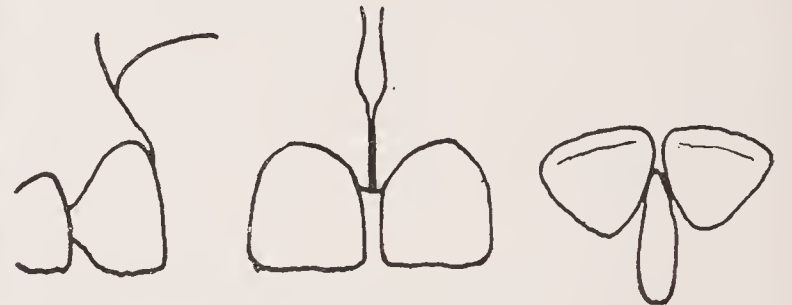
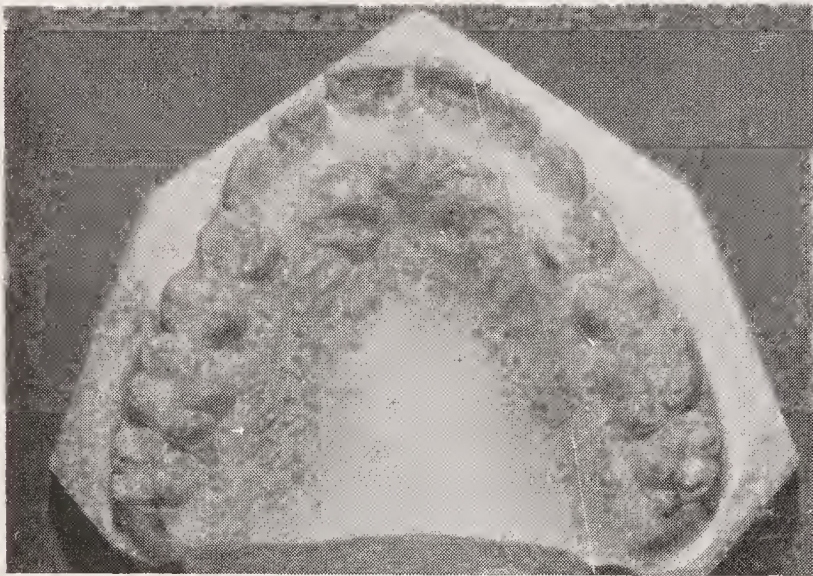
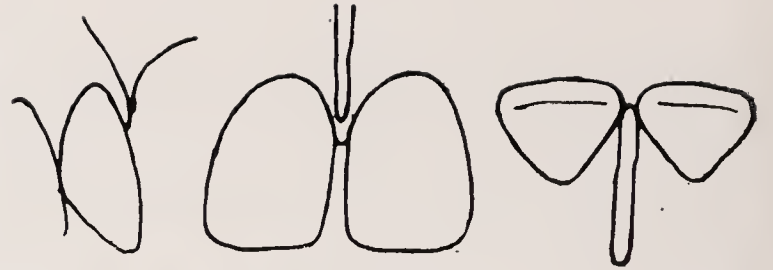


FIGURE 4

Between these two extremes lie many degrees of fraenal and incisive papilla development. Three of these intermediate stages should be distinguished and noted.

Firstly, there is the fraenum that almost but not quite reaches to the incisive papilla on the labial surface of the gingival margin. (Fig. 2). This fraenum is often quite large and comes well down but is just separated from the papilla by overgrowths of firm attached gingival tissue from either side.

Secondly, there is the fraenum which is neither unduly wide nor reflected unduly low down on the alveolar process, but which does not disappear immediately

below its reflection. It continues downwards as a smooth, slightly redder raised streak on the surface of the attached gingiva and in this form, runs down between the central incisors to the incisive papilla (Fig. 4).



Thirdly, there is the fraenum very much like the previous one which while disappearing below its point of reflection from the alveolar process, is continued downwards by a fine cleft in the attached gingiva which continues right through between the central incisors to the incisive papilla (Fig. 7).

These features are illustrated diagrammatically as they do not show up well in the photographs. The diagrams are drawn from the patient, although those cases having a cleft show this feature clearly on models. The diagrams are intended to bring out the following points.

1. The width of the fraenum.
2. The appearance of the fraenum if continued downwards on or in the gum below its point of reflection from the attached gingiva.
3. The appearance of the incisive papilla.
4. The point of reflection of the fraenum from the attached gingiva.

Sometimes it is not easy to show the point of reflection even in a diagram because the fraenum runs into a groove between the roots of the incisors and the point of reflection is difficult to represent diagrammatically or in a photograph and can only be distinguished clinically.

It is sometimes suggested that the inter-premaxillary suture has some influence in causing separation of the upper central incisors. The reasons for this and the

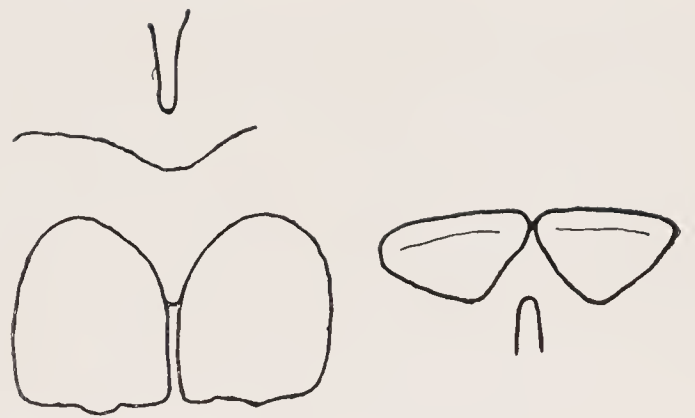


FIGURE 5

possibilities of this factor will be discussed later.

From consideration of the factors predisposing to spacing of the upper front teeth in general as discussed earlier, three types of case can be recognised in which there is a general tendency to spacing in the first instance.

The first type of case is that in which there is more room in the upper jaw than is necessary to accommodate all the teeth. If the term tooth-tissue ratio is used to designate the ratio of total dental arch size to the apical base or basal bone size, in cases of this kind it would be said that the tooth-tissue ratio is favourable or more than favourable. In this type of case, there is a general tendency to spacing of the teeth, particularly in the incisor region but also in some cases in the buccal segments.

The second type of case is that in which the upper incisors are proclined, for whatever reason this may have come about. As a result of the proclination, the crowns are spread onto a wider arch than

that which they would normally occupy and this leads to spacing.

The third type of case is that which is potentially normal but in which the anterior component has ceased to operate, due for example to loss, absence, defect in size or misplacement of a tooth or teeth.

The first kind of case is illustrated in Fig. 2. In such cases, there is a general spacing of the upper incisors due to an ultra favourable tooth-tissue ratio but the spacing occurs mainly or entirely between the central incisors. In the case shown, the fraenum is not attached particularly low down nor does it appear to be unduly thick. Certainly it is not triangular or wide as pointed out in the conventional illustrations of the "abnormal fraenum." There is evidence on the labial gingiva of the continuity of the fraenum with the incisive papilla and the incisive papilla is large and advances well up between the cingula of the central incisors, the fraenum can be seen to run to the incisive papilla almost directly. The spacing that occurs between the front teeth is localised between the central incisors.

Fig. 3 is a further example of a case with an exceedingly favourable tooth-tissue ratio and again the upper incisors are spaced, but in this case, the spacing is equally distributed between all the teeth. The central incisors are not unduly spaced in comparison with the space between the adjoining lateral incisors and canines. Here, however, the fraenum, while attached fairly low down, does not show the same evidence of connection on the surface with the incisive papilla. The tissue of the gum appears quite continuous between the two central incisors from the front view.

The second class of cases is characterised by proclination of the upper incisors onto a wider arch. This occurs as a rule in cases of Class II division 1 malocclusion and in cases of tongue thrusting. This proclination leads to a spacing of the incisors and canines, in some cases, this

spacing is localised between the upper central incisors, in others it is not.

Fig. 4 illustrates a case in which there is a tongue thrust but in which the buccal occlusion is normal. The upper incisors are spaced and the resulting spacing of the incisors is situated almost wholly between the centrals. The fraenum is narrow and reflected at a high level above the gingival margin. It is continued downwards, however as a fine cleft which runs between the central incisors to the incisive papilla which is large and which comes forward well between the cingula of the incisors.

Fig. 5 is another case in which there is proclination of the upper labial segment due to or associated with a tongue thrust. But in this case, the spacing that results is evenly distributed between all the incisors. The fraenum is a diminutive structure, being narrow and reflected from the gingival tissue well above the gum margin, high up in the labial sulcus. The incisive papilla is small, low and does not approach near to the cingula of the incisor teeth. There is no visible connection between the fraenum and the incisive papilla.

The third type of case is that in which the anterior component of force is deprived of its effect in cases that are otherwise normal. The loss of anterior component results in these cases from loss of dental arch length in relation to basal bone arch length.

In the case shown in Fig. 6, the lateral incisors are severely rotated leading to a diminution in dental arch length because a smaller diameter of the two incisors is presented in the mediodistal direction. The spacing that has resulted is situated exclusively between the central incisors. The fraenum is very large, it is not reflected from the alveolar process at all but runs directly into the incisive papilla. It is perhaps a moot point whether the lateral incisors are rotated originally leading to spacing of the upper front teeth or whether the fraenum kept the central

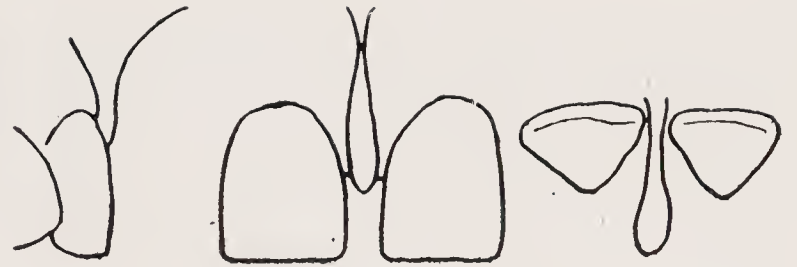
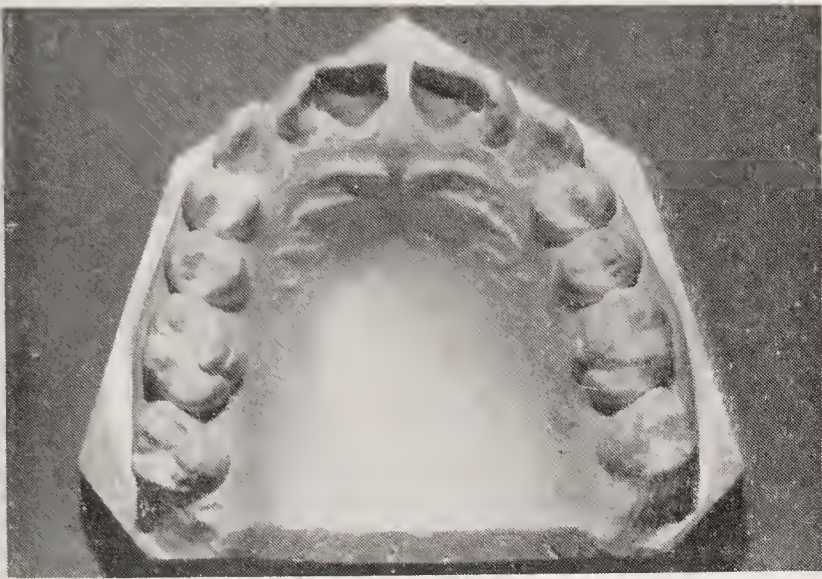


FIGURE 6

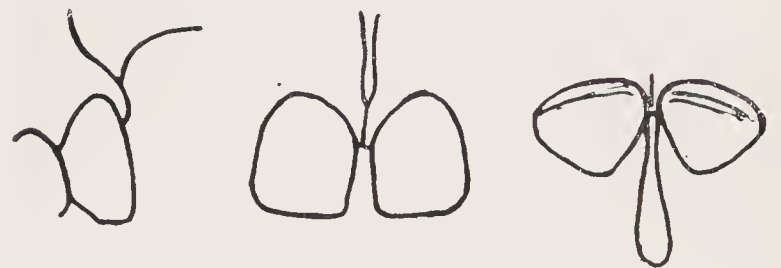
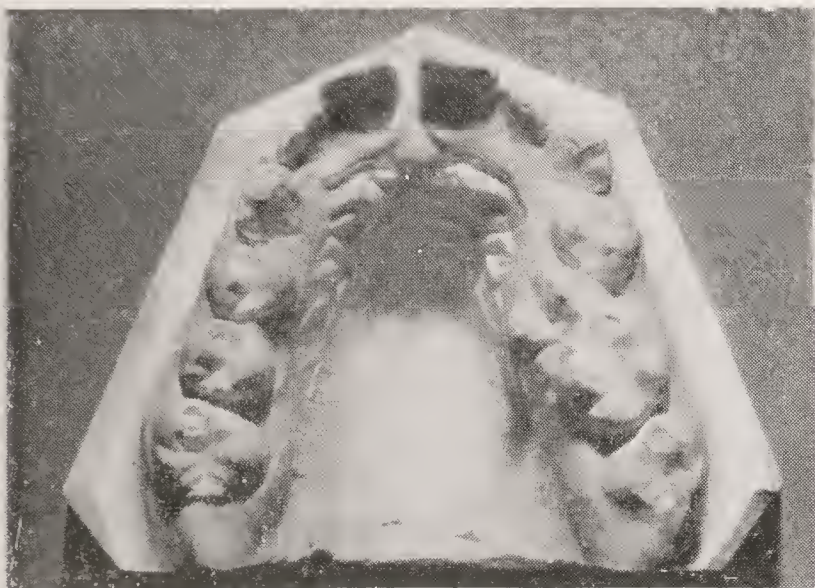


FIGURE 7

incisors apart and forced the lateral incisors into rotated positions. There are two arguments against the latter point of view. First, in most cases where there is a large fraenum but the incisors and canines erupt in normal alignment and the tooth-tissue ratio is normal, the fraenum does not prevent the central incisors from approximating. Secondly, the tendency for lateral incisors to develop and erupt in rotated positions in many cases is well known.

The case shown in Fig. 7 shows loss of continuity due to extraction of an upper first permanent molar on one side. Careful examination of the model and the patient shows that the gap between the central incisors is not in the centre line but that the right upper central incisor is a little to the right of the centre line. In this case the fraenum is not a large structure but it is continuous with the incisive papilla by a

fine cleft and the incisive papilla runs well forward between the cingula of the central incisors.

In the case shown in Fig. 7 there is to be seen the phenomenon of divergence of the crowns of the incisors. In cases like this, it appears clinically that the teeth diverge and that their apices are in their normal position or even closer together than normal. It is often suggested that the divergence of the crowns in such cases is due to the action of the fraenum separating them by its movements from side to side. An X-ray film of the central incisors of this case shows, however, that the apices of the teeth, far from being in their normal position or close together, curve laterally away from each other. Furthermore, in Fig. 8, the upper central incisors diverge as in the previous case but at the same time, they are as close together as it is possible for them to be. This is because



in this case, the dental arch is crowded, the tooth-tissue ratio is unfavourable, there is a vigorous anterior component of force and the teeth are firmly pressed together with continuity of the points of contact of the teeth. In this case also, the apices of the teeth may be seen to curve away from each other.

From all this it would seem that the phenomenon of divergence of the crowns of the upper central incisors is a phenomenon quite independent of the fraenum or any action that it may exert on the dentition. It is possible that this particular arrangement of the upper incisors is something that might be of interest to investigate on its own account.

The effect of loss of anterior component emerges in another type of case. This is the case in which extractions are carried out in the upper arch and subsequently a space opens up between the central incisors but not between the other front teeth.

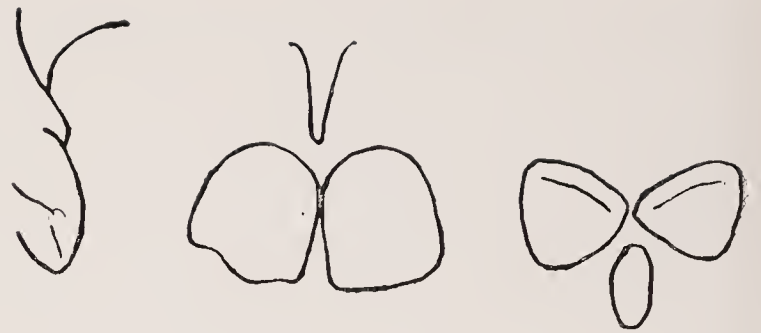


FIGURE 8

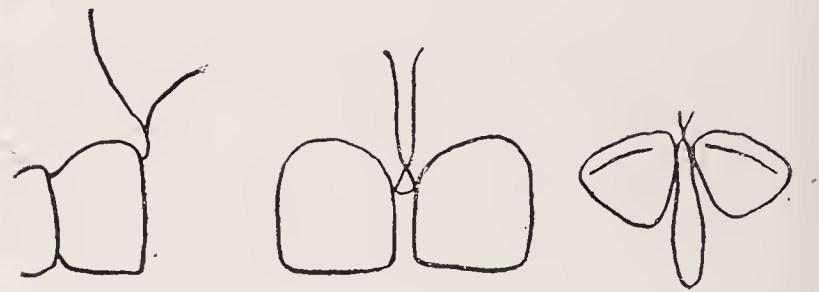


FIGURE 9

In Fig. 9 models are shown of a case in which the upper first premolars were extracted in order to correct irregularity of the front teeth in the upper arch. Before treatment was started, there was no spacing of the front teeth at any point. After the extractions were done, the patient wore an oral screen to encourage retroclination of the upper incisors, the canines were allowed to fall back into the premolar spaces of their own accord. At the end of treatment, the central incisors were markedly spaced. Examination of the fraenum and incisive papilla shows that the fraenum is well marked, wide and attached directly and visibly into the incisive papilla.

Fig. 10 illustrates a case in which similar treatment was used to produce retroclination of the upper incisors and canines where there was severe proclination of these teeth. In this case, the upper first premolars were extracted and the teeth in front of the

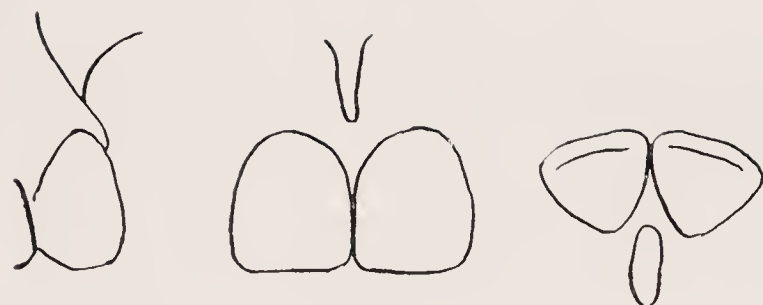


FIGURE 10



FIGURE 11

spaces retracted with appliances, beginning with the canines. It will be seen that when the canines were fully retracted, the incisors had spaced out and although support of these teeth from the distal aspect had been entirely removed, the resultant spacing was evenly distributed between the teeth. In actual fact, the lateral incisors started to move away from the centrals before the centrals started to space at all. In this case, the fraenum and incisive papilla are small structures and have no visible connection of any kind, the fraenum being reflected well above the gum margin.

The last case (Fig. 11) shows an instance in which there is no spacing of the upper incisors but in which there is a well defined fraenum attached low down and in clear continuity with the incisive papilla. The important point to note is that in this

case there is continuity of the contact points, the anterior component of force appears to count as a factor in the balance of these dental arches. The occlusion and arrangement of the teeth is normal.

The question of the inter-premaxillary suture has been raised from time to time in connection with spacing of the upper central incisors and it is sometimes suggested that spacing of these teeth is caused in some way by this suture.

It was first thought by Angle that the "abnormal fraenum" was due to an abnormal suture. Angle, however, quotes and agrees with Ketcham, who studied a considerable number of abnormal and normal fraena and spaced and unspaced central incisors, and concluded that the attachment of the fraenum, whether normal or abnormal, is in no way related to the suture.

Gillies (1935) attributes spacing of the upper central incisors to the presence of bone between their roots holding them apart rather than to the presence of a large fraenum, and states that the removal of sufficient bone causes the teeth to come together or facilitates their approximation mechanically.

Chapman (1935) examined a number of cases with particular reference to the inter-premaxillary suture with a view to defining the kind of case in which approximation of the incisors will eventually take place and those in which it will not.

Possibly as a result of the influence of these two papers, there seems to be a feeling to-day in this country that the suture has some effect in causing spacing of the incisors. On this account, in many cases where operation on the fraenum is decided on, the contents of the inter-premaxillary suture are also removed.

There is little evidence to show that the inter-premaxillary suture has any influence in causing spacing of the upper central incisors. If the suture ever showed signs of being much wider than it usually appears to be radiographically it might then be feasible to suggest that it keeps the roots and hence the crowns of the teeth apart. The suture never does, however, appear to be as wide as would be necessary to produce this effect. The X-ray of every case used in the present paper has been included. In some cases, the suture is longer than in others but there has been little to distinguish the appearance of the sutures in those cases in which the incisors have been spaced from those in which the incisors have been in contact. Nor does there appear to have been any particular connection between the size of the fraenum and the width of the suture. This is apparent from a comparison of Fig. 1 with Fig. 5.

With regard to the "persistent suture" the inter-premaxillary suture persists normally into late adult life and it is unlikely

that persistence of the suture has anything to do with spacing of the central incisors.

In those cases in which spacing has occurred exclusively or predominantly between the upper central incisors, it would seem that the fraenum has played a part in producing the spacing. In these cases the fraenum has not necessarily been large, wide or attached low down on the gingival margin, in the manner of the conventional "abnormal fraenum."

It is suggested that the connection between the fraenum and spacing of the incisors is indirect and that in fact the fraenum operates through or in conjunction with a general tendency to spacing of the teeth in the upper arch. This tendency may be due to a favourable tooth-tissue ratio, meaning a greater amount of room in the maxilla than is required for all the permanent teeth; or due to expansion of the anterior segment of the upper arch due to proclination of the upper incisors; or due to loss of the interproximal dimension of the dental arch in cases that are otherwise normal. Once the conditions for spacing have been established, the fraenum appears to operate to determine the site of all, or the greater part of, the spacing that results.

It has been shown that mere bulk of the fraenum does not necessarily keep the incisors apart nor is it movement of the fraenum that spread the crowns of the incisors in a divergent manner. The following explanation of the way in which the fraenum exerts its influence is tentatively advanced.

It has been suggested by Scott (1952) that the transseptal fibres of the periodontal membrane link the teeth together into a continuous chain from end to end of the dental arch. Experiment has shown that when a tooth is lost, part of the process of repair of the wound consists of the establishment of a band of fibrous tissue stretching across the empty socket connecting the transseptal fibres of the teeth on

either side of the one that was removed. (Chase and Revesz, 1944). As this band of fibrous tissue matures it must contract and it is possible that this contraction is partly responsible for the tilting together of the teeth that lie on either side of the space left by an extracted tooth.

If this conception is extended a little further, it may be correct to think that there is to some extent a state of tension in the dental arch from one end to the other due to the linking together of the teeth through the transseptal fibres. This tension would only exist in those dentitions in which there was a tendency to spacing, that is to say in cases falling into the three classes that have been discussed and illustrated. In those cases in which the tooth-tissue ratio is harmonious or inadequate, it is suggested that there is not a state of tension but a state of pressure due to the anterior component of force.

If now in those cases in which there is a tendency to spacing the fibrous band linking the teeth is broken at any point without any loss of teeth, it is possible that the two elements of the chain so separated might draw apart leaving a gap at their ends at the site of division of the fibrous band.

This is possibly what may occur at the site of the superior labial fraenum. The fraenum does not need to be a thick structure to interrupt the transseptal fibres of the periodontal membrane. As long as there is evidence that the fraenum is still not fully overgrown by the attached gingiva it seems reasonable to suppose that the break in the transseptal chain exists. The presence of a streak continuing downwards from the reflection of the fraenum, or a cleft in the gingiva suggesting that the fraenum has been but incompletely overgrown by the gingiva would seem to indicate that the transseptal fibres at that point are incompletely formed.

Histological examination of complete specimens of this part would produce

further evidence on the point. Such specimens would have to be of sufficiently developed dentitions to show the necessary clinical feature of spacing of the upper central incisors and specimens of this kind would not be easy to obtain. Meantime, microscopic examination of fraena alone excised as a treatment measure shows that the constituent tissue, white fibrous tissue mainly, runs as a band in an antero-posterior direction without any appearance of transverse fibres in the same neighbourhood. This is confirmation of a kind that the transseptal chain is broken at this point but more extensive histological examination of this area using more complete material would have to be done.

In conclusion it is suggested that because the distinction between an "abnormal fraenum" and a "normal fraenum" has never been drawn and because there is reason to believe that the fraenum never produces its effect directly, the term "abnormal fraenum" should not be used. It is suggested that in fact the term "abnormal fraenum" is meaningless. There are large fraena and small fraena. Both kinds can lead to spacing between the central incisors but this spacing is dependent also on the operation of other factors simultaneously.

The author wishes to acknowledge with gratitude the assistance that was given in the production of this paper by Mr. D. R. McDougall, Department of Photography, Eastman Dental Hospital, who prepared the original photographs of models, diagrams and patients and the final lantern slides and illustrations, Miss S. Jenkins, Librarian, Institute of Dental Surgery who drew up the bibliography and members of the staff of the Eastman Dental Hospital, too numerous to mention, who referred cases showing the condition which is the subject of the paper.

The Editor regrets that it was necessary to omit some illustrations.

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DISCUSSION

Mr. M. A. KETTLE, in opening the discussion, said that the problem of median diastema together with the great variation of associated factors was one which greatly concerned everyone. Mr. Adams was to be congratulated on the admirable way in which he had presented his subject to the Society. He had put an immense amount of work into the collection of the material and the preparation of the excellent slides.

Mr. Kettle said he was sure there would be general agreement with the statement that the fraenum in itself had no direct effect on the production of median diastema. Unfortunately the problem was not as simple as that, nor did it involve the fraenum alone. In 1953 Mr. Chapman presented a paper to the Society in which he expressed the hope that a means might be found of establishing a differential diagnosis for these cases. It would indeed be most valuable if knowledge in this

respect could be furthered.

The condition which was of immediate interest to the Society was the one with median diastema of aetiology at present unknown. All the incidental factors such as congenitally missing teeth, supernumerary teeth in the midline, lack of balance in the tooth tissue ratio and associated habits should be put on one side. He suggested considering the apparently normal arches in normal relationship with this one factor present.

Mr. Kettle said he found it hard to reconcile himself to the suggestion that had been advanced that a break in the chain of the transeptal fibres by an abnormal fraenum could bring about separation of the teeth. They were of non-elastic white fibrous tissue and it was difficult to see how they could act in a negative way in the face of a natural mesial drift of the teeth; should that phenomenon occur. Again, it was claimed that post-extraction scar

tissue would tilt together the teeth on either side of the space. The scar tissue resulting from fraenectomy should do the same, but in his experience this was not necessarily the case.

As he saw it, there were four main issues to be considered:—

- (1) The presence of a large fraenum.
- (2) The amount of bone between $1/1$.
- (3) The presence and possible activity of the midline suture.
- (4) The influence of mesial drift exerting pressure on $1/1$.

(A series of slides were then shown which illustrated these factors).

Mr. H. CHAPMAN showed slides made eighteen years ago and others of later date. Mr. Kettle had summed up the situation in a slide showing a permanent separation of $1/1$ in which the arrangement of the bone was different from what he regarded as normal. In the normal the bone appears as two Vs, of compact bone in contact medially, $\backslash\backslash/$, the legs of the Vs in the centre line forming part of the intermaxillary suture and the other leg corresponding to the root of the tooth: each V is filled in with cancellous bone. He had only seen this appearance when the centrals are in contact and believes it to indicate that if not already in contact they will in time come into contact though perhaps not until age 14 or later, but usually it takes place earlier.

In cases in which the upper centrals are permanently separated the appearance is different, there is the compact layer against the medial side of each central but between there is bone of an indefinite cancellous appearance which may not fill the space entirely; he showed one such case in which the centrals had been brought together but they had relapsed. The spaces vary in degree and he did not believe they could be closed permanently. This is a question which would repay further research, particularly by means of serial x-rays. He had seen an example of each condition

before 6 years of age, permanent centrals unerupted, but had not had the opportunity to follow them up.

He thought the members should be very grateful to Mr. Adams for having dealt with the whole matter so exhaustively. He himself had dealt in his remarks with only one aspect of it, but Mr. Adams had dealt with every aspect of it. He thought that the slides shown by Mr. Adams confirmed the view which he himself had put forward. In Mr. Adams' last two cases the bone came to a sharp point and there were good arches and no spacing, and Mr. Adams had shown several cases in which the bone was not defined like that and in which the spacing was present. He was sorry that Mr. Adams had not gone into more detail about that, because he believed that it was the fundamental point on the question of the spacing. He hoped that Mr. Adams, who had got X-rays of all his cases, would summarise the matter, so that the members would know his views on it.

He thought that sometimes the condition was a familial one.

Mr. H. G. WATKIN said that he was very interested in Mr. Adams' paper and would like to thank him for the exhaustive way in which he had dealt with the subject.

He had heard many practitioners say that they always removed the fraenum, but he thought Mr. Adams had shown that one should be very careful in deciding whether that was necessary, and as a matter of fact it was very rarely necessary.

There was one little practical test which he thought was useful. Mr. Adams had mentioned pressure round the arch contact points and had said that it was not always present. A very simple way to discover whether it was present or not was to take a thin piece of stainless steel tape (0.1 mm.) and pass it between the teeth. If one had difficulty in passing it interstitially there was pressure. If it went between easily, there was little or no pressure.

With regard to the condition being

familial, twenty years ago he had a patient with a wide space between I/I and she brought her daughter to him, because the daughter also had a similar wide space. She had a very big fraenum, which he removed, and in about six months the gap disappeared. Six months later the same patient brought another daughter with the same condition, and he removed the fraenum, with the same result. He thought that in such cases it was absolutely necessary to remove the fraenum.

Mr. H. E. WILSON congratulated Mr. Adams on his very exhaustive and valuable paper.

In regard to a number of the cases which he had shown, Mr. Adams had not said that the spaces would probably close in time, but he supposed that Mr. Adams meant that to be taken for granted.

Mr. W. J. TULLEY said that he also would like to congratulate Mr. Adams on his very fine analysis of the subject.

He thought that Mr. Adams had not made quite clear the question of when he would do a fraenectomy and when he would not do a fraenectomy. He felt that the decision depended not only on the treatment from the point of view of closing the diastema but also on the condition of the fraenum. If the lip was not moving freely against the labial surfaces of the upper teeth or was so low that it showed a double fold hanging in the patient's mouth, that might be an indication for a fraenectomy. He would like to hear Mr. Adams' views on that point.

Mr. J. H. HOVELL said that he did not wish to be discourteous to Mr. Adams, but he felt that the members had been brought to the meeting under false pretences, because they all knew the various features of the dento-facial complex which caused separation of central incisors, small teeth, large arches, and so forth. What he had hoped to hear from Mr. Adams but had not heard from him was the function of the fraenum in causing separation of the incisors when there was no other factor

involved. He did not think that Mr. Adams had really explained that; in fact, Mr. Adams had not done as much towards explaining it as Mr. Chapman had done in 1923. He thought it was time that orthodontists took this matter in hand and found out the answer. It was a fairly simple matter. Surely some full-time teacher in a university or some consultant not burdened with practice could find out the cause of the separation of the incisors when there was no other factor in the patient's complex which caused it.

Mr. R. V. TAIT said that he had come to the meeting hoping for more light cast on the problem than Mr. Adams had cast on it, and he would like to congratulate Mr. Kettle for having helped in this connection.

He did not think it was right to say that there was no such thing as an abnormal labial fraenum, although that one had not been shown on the present occasion. He thought that all the members must at one time or another have seen a rope of fibrous tissue passing between the upper incisors into the palate. It was rare but very spectacular and was often associated with gross displacement of the upper incisors. He did not think it could be said that that was not an abnormal fraenum.

Apparently at the Eastman Dental Hospital the fraenum was still removed in some cases. That might, of course, be simply because the orthodontists there wanted to look at the histology, but he would like to know the reasons for and results of this operation. Were there any clear-cut cases in which when the fraenum had been removed either the incisors had moved together spontaneously or it had been possible to move them together, and they had stayed together?

In connection with that, he would like to ask Mr. Adams or any other member to advise him what was the right thing to say to parents on the problem in question. There was one on which in practice orthodontists were often consulted. Children were frequently referred to him with a

note from a general dental practitioner to the effect that they required fraenectomy, but it had been his practice in every case to advise the parents that, if the gap would ever close in any circumstances, it would do so of its own accord. Any treatment directed to that end was likely to be a failure, except in those cases in which closure would in any case take place. He would like to know whether that opinion was sound or not.

There was one aspect of the matter which had not been discussed at all on the present occasion but on which some of the members might have views, namely, a diastema between lower central incisors. He had never seen that himself, but it might sometimes occur. It seemed to him that in the lower jaw one was dealing not simply with one fraenum but actually with two fraenums. There was a lingual fraenum, which was sometimes attached to the alveolar ridge. If the fraenum was of such importance in separating the incisors, one would expect, at any rate occasionally, to see the condition in the lower jaw. However, he thought that one was dealing with a completely different type of suture in the lower jaw, and by the time one saw the patients there was bony union across the midline. He wondered whether this difference in type of joint between the two halves of the jaw was relevant to the problem.

Mr. H. G. WATKIN, referring to the case of the mother and her two daughters which he had quoted, said that as the spaces closed up when the fraenum was removed and nothing else was done the fraenum was very likely the cause of the trouble in these cases.

Mr. J. H. HOVELL said that an investigation on the subject would be difficult because of the difficulty of getting controls. It would be necessary to have a sufficient number of identical cases; one would have to get a number of identical twins and remove the fraenum in one of the twins but not in the other.

With regard to the cases to which Mr. Watkin had referred, he agreed that the fact that the space disappeared when the fraenum was removed furnished a strong presumption that the fraenum was the cause of the space, but it did not prove it. He had seen a case in which the fraenum passed round the distal side of the incisor and apparently caused it to rotate, but there was no proof that it did so. One of the first things that should be done was to try to obtain absolute scientific proof, not merely presumptive evidence based on clinical observations.

Mr. H. LEECH said he would like to thank Mr. Adams for his exhaustive paper.

Mr. Adams had not referred to the hereditary diastema. Very often one saw a child with a space between the centrals and the mother said that the child's father and grandfather had also had a space there. He would like to know whether there was any connection between a diastema and a normal fraenum. Also, he had had a patient with a diastema, and the lower lip tended to get between the two bottom incisors and appeared to keep them apart. He would like to know whether Mr. Adams thought that there was any cause for the diastema other than an abnormal fraenum.

Mr. C. P. ADAMS, in replying to the discussion, said that he had forgotten to state at the end of his paper that a great deal of work still needed to be done on the subject. He had observed that that statement was made at the end of most papers, and he thought it was particularly true of the subject with which he had dealt in his paper. He had been convinced of that before the discussion on the present occasion, and he was even more firmly convinced of it now.

He wished to thank all those who had dealt so kindly with his paper, and he would try to answer some of the questions as far as he had been able to take them down, but they had come very thick and fast.

He would like to thank Mr. Kettle very

much for his contribution to the discussion and for the illustrations of his own cases which he had shown. He did not think that the question of the appearance of the bone between the central incisors was at all important. Alveolar bone was different morphologically in different situations, but histologically it was all the same. He thought there was nothing to show that the central incisors which had a block of bone between them could not be brought together. After all, if the central incisors were spaced there must be something between them, and it was very natural that it should be bone. In the alveolar region, at any rate, he thought it was generally agreed that the alveolar bone developed in connection with the denture. If there were teeth there was alveolar bone, and if there were no teeth the alveolar bone did not develop. The position of the teeth and the arrangement of the teeth were determined by the factors which he had been at some pains to discuss in his paper, and, if those factors led to a spacing of the teeth, it was quite natural that there should be bone between their roots. If they were widely spaced, the bone would be flat, and if they were close together the bone would be pointed between the necks of the teeth. That the bone actually kept the teeth apart was, he thought, a misconception. In each of his cases he had shown a picture of the whole dental arch, but neither Mr. Kettle nor Mr. Chapman had shown the general form of the dental arch, and he thought it was quite impossible to explain how the front teeth were arranged merely from an X-ray of the premaxilla. The subject was wider than that, and he thought it was necessary to have the full facts of the case before it was possible to dogmatise about the arrangement of the teeth. He had attempted to produce all the relevant facts without going so far as to produce pictures of the face and X-rays of the skull. He thought that the form of the upper arch was sufficient.

Mr. Kettle had very kindly confirmed

his own statement that the size of the fraenum bore no relation to the size of the suture, and Mr. Kettle had some cases which showed closure of the space between the central incisors in the presence of a really colossal fraenum. If those cases were substantiated by illustrations of the whole dental arch they would be very valuable indeed.

With regard to white fibrous tissue and its behaviour, he had said in his paper that he was taking a risk in venturing into the field of anatomy and histology. While white fibrous tissue did not contract in the sense in which elastic tissue contracted, he thought he was right in saying that white fibrous tissue was arranged in a spiral manner and for that reason had a certain amount of contractility, because it was under tension in most instances, rather like a coiled spring. With regard to the contraction of fibrous tissue in a space caused by the extraction of a tooth, fibrous tissue contracted as it developed and matured. There were therefore two forms of contraction, which he thought could not be overlooked.

He would like to thank Mr. Chapman for his kind remarks. He had paid particular attention to Mr. Chapman's paper in 1935. It was to a great extent that paper which had started him on his present investigation and he was very much indebted to Mr. Chapman on that account.

He thought that most of what Mr. Chapman had said was related to Mr. Kettle's contribution to the discussion.

With regard to the question of the block of bone, he did not think a block of bone kept the teeth apart. The positions of the teeth were determined by other things, outside the alveolar process. The alveolar process was, to a great extent, secondary. He wanted to emphasise the fact that the presence of alveolar bone was dependent on the presence of teeth.

He would like to thank Mr. Watkin for his kind remarks and interesting questions.

He hoped that his paper would not start

a spate of fraenectomy operations under the National Health Service. He would be unpopular at Eastbourne if it did.

He did not quite agree with Mr. Watkin's test for the presence of pressure. If there were two jam pots on the table and he thrust a ruler between them, he would get a pressure on the ruler, but that did not mean that the two jam pots were hugging each other before the ruler came along. Mr. Watkin caused pressure by inserting the tape, but that did not prove that there was pressure there before the tape was put in.

He would like to thank Mr. Wilson for his remarks. What he had said in his paper about transeptal fibres was subject to Mr. Wilson's criticism, but it was contained in the authoritative material upon which he had drawn in that connection, and orthodontists had to be prepared to accept a great deal of what the anatomists told them about the results of their anatomical and histological work.

With regard to the cases in which the spaces would later close up, it was true, as he had pointed out in his paper, that the spaces did in some cases close up. His purpose had not been to try to define the classes of cases in which closure of the spaces could be expected. He thought that that was a very narrow aspect of the subject. If one considered the factors which were related to the presence or absence of spacing, it was quite easy to see which were the cases in which the spaces would close up and which were the cases in which they would not. He thought it would be futile to give a set of six rules which would indicate the cases in which the spaces would close up. It was necessary to understand all the conditions which were related to the spacing of the incisors.

He would like to thank Mr. Tulley for his remarks.

The question of when to do a fraenectomy was concerned with another aspect of the subject with which he had not intended or presumed to deal, namely,

the subject of treatment. He had tried to analyse the factors as he found them. His practice was to watch the development of the spacing and to see whether there was a tendency to closing, but not to do anything until all the deciduous teeth had been lost and had been replaced by permanent teeth and it was apparent that in the course of development the space was not going to close. If there was a large amount of spacing, the thing to do was to distribute the spacing evenly between the front teeth by doing a fraenectomy and approximating the central incisors, and then allowing the conditions to settle. He had not a large number of treated cases, because fraenectomies were not done a great deal even at the Eastman Dental Hospital for histological purposes. It was necessary to limit histological examination to cases which were treated of necessity and not for experimental purposes.

Mr. Tulley had mentioned the binding down of the lip, and that was a quite important factor. Adult patients who had suffered with the spacing for many years found that when the fraenum was removed they could speak better and were able to produce facial expressions which they had never been able to produce before. Many of these patients were very impressed by the new sense of freedom which the operation gave them, in speech and expression, and that was a very important aspect of the subject.

He very much appreciated Mr. Hovell's remarks and the spirit in which they had been made. It was quite true that it was necessary to sweep aside scientific insincerity and really get down to the facts and prove one's contentions.

Mr. Hovell's point that he had not produced a case in which the fraenum caused spacing of the central incisors showed that Mr. Hovell had mistaken the purpose of the paper, which was to make it clear that in no case did the fraenum produce spacing of the central incisors by itself. The cases which he had shown and

those shown by Mr. Kettle showed that the fraenum did not by itself produce spacing of the central incisors. There was a complicated balance. Nothing was absolute; no factor was dominant in the complex make-up of the arrangement of the teeth. It was impossible to be as dogmatic as Mr. Hovell desired, but he thought the analysis showed that no single factor was responsible for producing the spacing of the incisors. He would be interested if Mr. Hovell could produce a case in which the fraenum by itself caused spacing of the central incisors.

He would like to thank Mr. Tait for his remarks, in which there were many germs for future work.

With regard to grossly misplaced upper incisors, it was necessary to decide whether they were grossly misplaced because of the fraenum or whether the gross misplacement was coincidental with the large fraenum. In that connection one was handicapped by lack of cases. He thought it was a fact that an extraordinary case encountered early in one's career could turn one's mind along a certain train of thought for the rest of one's life, place in one's mind explanations for succeeding cases of a similar nature, and bias one's conclusions on the subject, which were not carefully substantiated and checked by an analysis of similar types of material.

He admitted that there were to be found (although he had not any in mind) cases of very gross malformation of the buccal sulcus, which was formed at a very early embryonic stage, and it was a question whether such cases could not be put into the class of frank pathology of development or serious malformation such as occurs in clefts, and malformations of that kind. He had no evidence of this type of case, however, so it was difficult for him to discuss it.

At the Eastman Dental Hospital fraena were removed for treatment purposes, when it was clearly apparent from a full analysis of the case that the space would

not close and it was in fact necessary to close the space. Advantage was taken of these operations to acquire material for histological examination. It was very difficult to obtain cases of fully grown adults with all the teeth present and with this space, with or without a fraenum.

With regard to the results of frae-nectomies, that was a subject for another paper and he had not intended to embark upon it at this juncture. It would require a good many years' work at one place, where one could collect a mass of material for analysis.

As to Mr. Tait's view that if a space was going to close up it would do so of its own accord, one could only tell that by waiting to see whether it would close up of its own accord, and, if it did not, then was the time to do something about it. He thought it was as well to give the developing dental arch the benefit of the doubt and see what it was going to do by itself.

He thought that the parents should be told that the space frequently occurred in growing children, that it might close up or it might not, and that it was worth while waiting to see.

Much more work needed to be done on the question of diastema between the lower incisors, and his own guide, philosopher and friend in orthodontics had advised him to consider many further aspects of the subject, such as the anatomical, embryological and hereditary aspects, including the study of identical twins, in which case the clinical material was inclined to be limited.

He had confined his efforts to the clinical aspects of the subject. The histological and other aspects of it required a university atmosphere and university facilities, and a good deal of time and training if these aspects were to be adequately and authoritatively studied, but the work needed to be done and possibly it would be done in the next few years, if not by himself and his colleagues by other people who were interested in the subject.

The question of the lower jaw fraenum was a very interesting one. He had seen cases in which there was spacing of the lower central incisors, but a different situation, a different set of circumstances, and different histological and anatomical factors were involved. The subject was one for another paper.

The hereditary aspect of the subject was very important. Some work had been done upon it in Germany, but he had not studied the matter so far. He hoped to do so at a later date.

He felt that he had not replied to the discussion adequately. He had had difficulty in making a note of the questions,

and he would like to have given a considered reply to them in writing, when he had had an opportunity of seeing them in type.

The PRESIDENT, in proposing a vote of thanks to Mr. Adams for his valuable paper, which had been very well presented and had given rise to a vigorous discussion, said that he hoped Mr. Adams and his colleagues would present further information on the subject at a future meeting. He would also like to thank Mr. Kettle for opening the discussion, and Mr. Chapman and the other speakers who had contributed to it.

The Development of Ideal Occlusion of the Gum Pads and the Teeth

SHELDON FRIEL, M.DENT.SC., SC.D.(*Dubl.*) F.D.S.R.C.S. (*Edin. and Eng.*)

THE subject of my lecture is the development of ideal occlusion of the gum pads and the teeth, and it is a subject that appealed to the late Dr. Northcroft. I think he was the first to use the term "ideal" in connection with occlusion. The Nomenclature Committee of the American Association of Orthodontists¹ recently defined "ideal occlusion" as "Basically a myth; it is a figment of the imagination."

Is it not a waste of time to give a lecture on something that is supposed to be a myth and that never occurs? I do not like that definition. Ideal occlusion² does occur in Nature, but in decreasing numbers as the final stage of development is reached, and to my mind it is the most important form of occlusion to be known. Any other forms of occlusion are a comparison with the ideal, such as "individual normal," "average normal," and so on. Ideal occlusion is not easy to learn, as it is not static. It is changing all the time as the individual grows and develops.

At the First International Orthodontic Congress in 1926,³ I read a paper on the same subject. Fortunately, I have not had to alter it much. I have had to add to it, mainly as the result of other people's work, and to give additional evidence in support of some of the more controversial points.

I have divided the article into two parts. Part I presents a description of ideal occlusion, and Part II is devoted to a discussion of the evidence in support of some of my assertions.

PART I

The stages of occlusion are as follows:

A. *The Relation of the Gum Pads at Birth.*—The form of the gum pads; the increase in size of the alveolar arch from birth to the time of the eruption of the deciduous teeth; the position of the deciduous teeth in their crypts; and the direction of eruption and morphologic characteristics of the deciduous molar teeth that guide them into occlusion.

B. *The Occlusion of the Deciduous Teeth at 2½ to 3 Years of Age.*—The relation of the distal surfaces of the second deciduous molars; the position of the permanent incisors in their crypts; the manner in which room is obtained for the larger permanent incisors; the change in relationship of the mandibular to the maxillary arch, and the reasons why this change is necessary.

C. *The Completion of the "Mixed" Occlusion (Permanent Incisors and First Permanent Molars, Deciduous Molars and Canines).*—The change in relationship of the first permanent molars following the loss of the deciduous molars and canines.

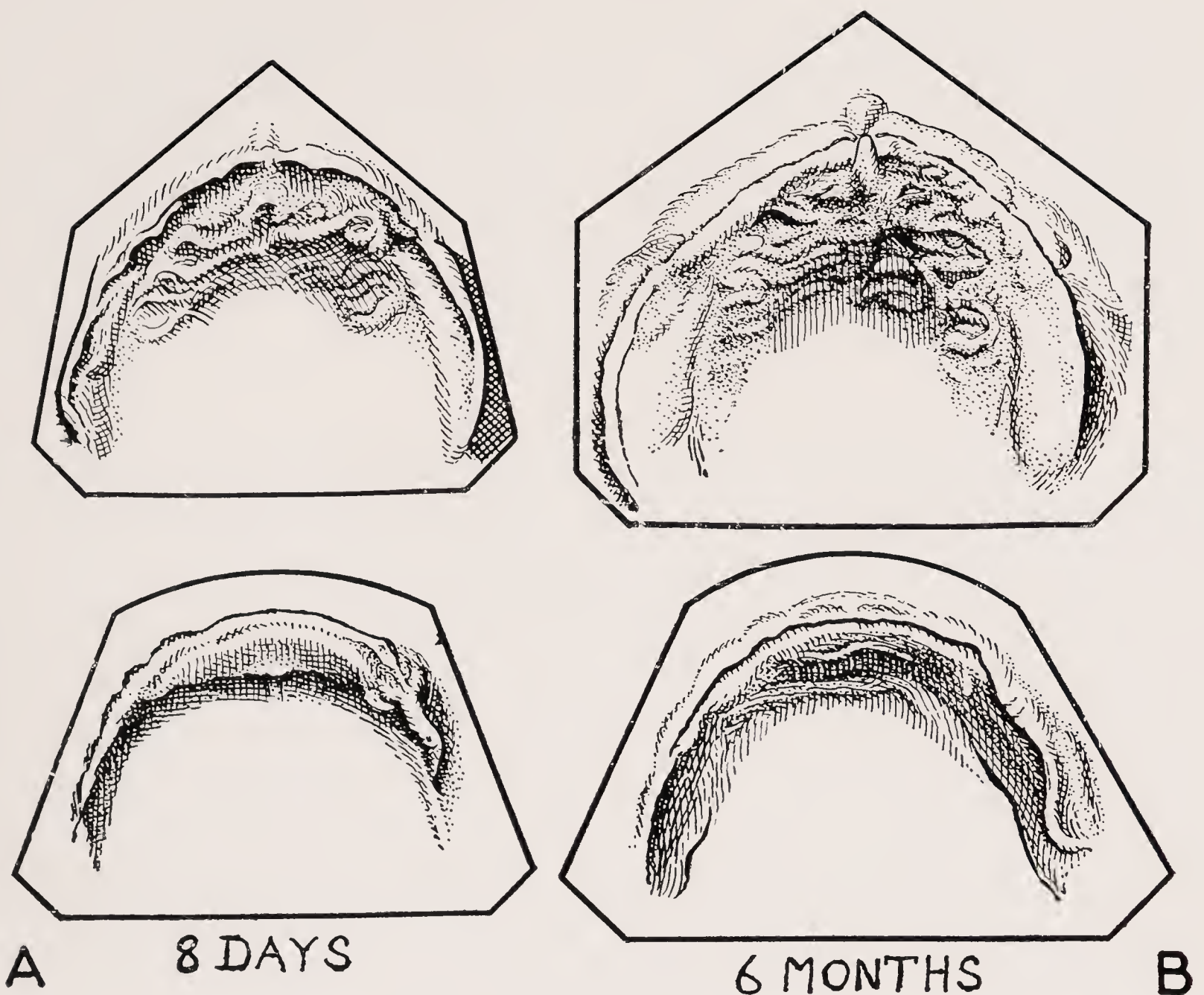


FIGURE 1

Drawing of gum pads of the same infant. A, 8 days old; B, 6 months old. Showing form of gum pads and increase in size in 6 months. (From Clinch: Tr. British Society for the Study of Orthodontics, 1932.)

The Fifth Northcroft Memorial Lecture, given before the British Society for the Study of Orthodontics, November, 1951.

D. The Completion of the Permanent Occlusion.

E. The Changes That Occur as the Result of Wear.—Incisal edges, cusps of premolars and molars, and interproximal surfaces.

A. The description given by West⁴ of the form of the gum pads at birth is the best. He shows the division of the pads into sections which correspond to the underlying deciduous teeth. The sections for the second deciduous molars are very poorly defined at birth and do not really show until about 5 months of age. Miss Clinch,⁵ in her serial models from birth to 3 years of age, demonstrates the increase in the size of the alveolar arches from birth to the time just before the eruption of the incisors. The arches increase in both

length and breadth (Fig. 1). The maxillary gum pad is larger anteroposteriorly and transversely than the mandibular, and in occlusion overlaps it in front and at the sides just like the arrangement of teeth. The groove separating the canine and first molar segment in the maxilla is somewhat distal to the corresponding mandibular groove. This groove has disappeared by the swelling of the incisor section by 6 months of age. In occlusion the first molar area is the only part that is in contact at birth, leaving an oval gap in the incisal and canine area and the second molar areas diverging from each other in a sagittal direction (Fig. 3).

Some difference of opinion exists as to whether these infant models should be



FIGURE 2

Diagram (A, before birth) showing positions of deciduous teeth in their crypts, Rotation of maxillary lateral incisors, and rotation of mandibular central and lateral incisors. B, 3 years of age, showing the position the deciduous teeth should assume. Considerable increase in the size of the arches was necessary.



FIGURE 3

Drawing of gum pads in occlusion (at birth). Mandibular arch slightly distal and lingual to maxillary arch. Vertical oval space in incisor region. First molar segments only in contact. (From Clinch: *Tr. British Society for the Study of Orthodontics*, 1932.)

articulated⁵⁻⁷ in occlusion or at rest, leaving a freeway space between the gum pads. Both are correct in their own way, just as models can be articulated with the teeth in occlusion or showing the freeway space.

At birth the alveolar arches are so small that the teeth in their crypts, especially in the incisal area, are rotated and packed together.⁸ In the maxilla the lateral incisors are rotated distolingually at nearly right angles to the central incisors and are overlapped by the canines, or they may lie

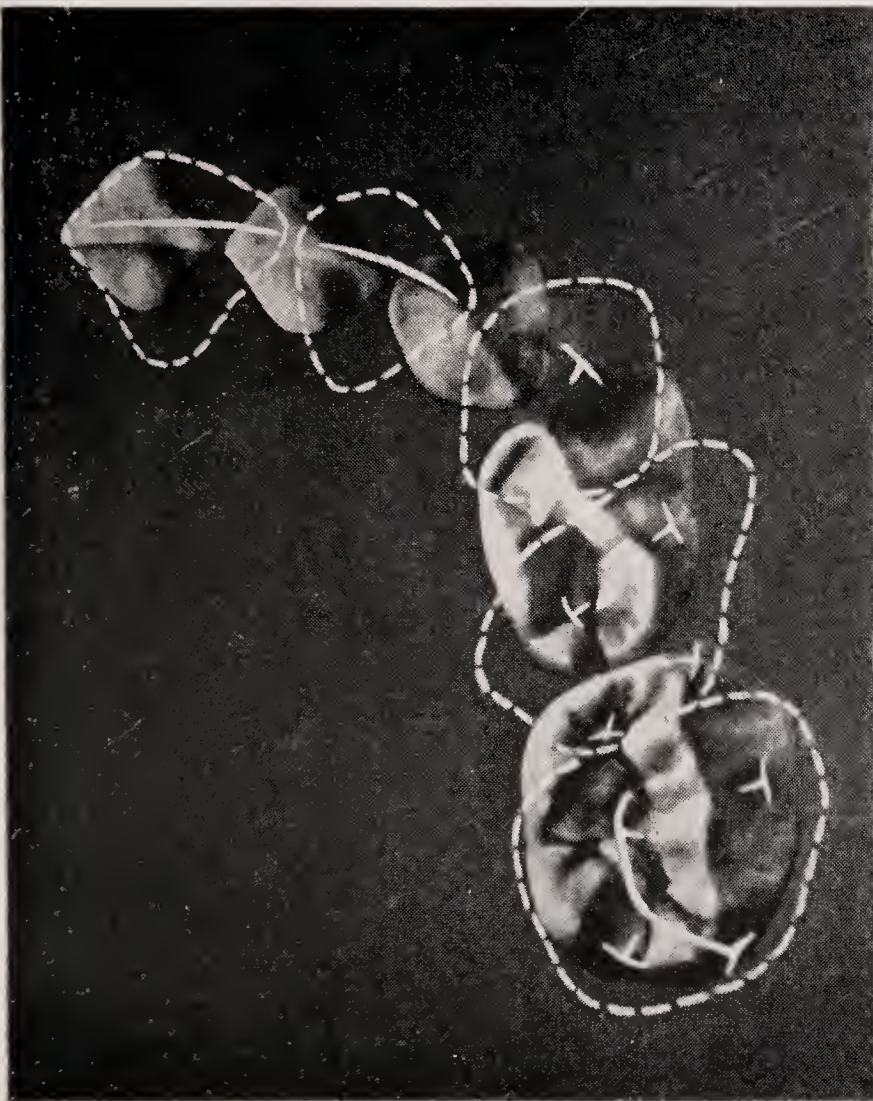
lingual to the centrals. In the mandible, both central and lateral incisors are rotated, the centrals mediolingually and the laterals distolingually and again overlapped by the canines. (The persistence of this arrangement can be seen frequently after eruption in underdeveloped jaws). The increase in the size of the arches between birth and the time of eruption of the incisors allows these teeth to rotate and even to have spaces between them (Fig. 2).

The projection of the maxillary arch in

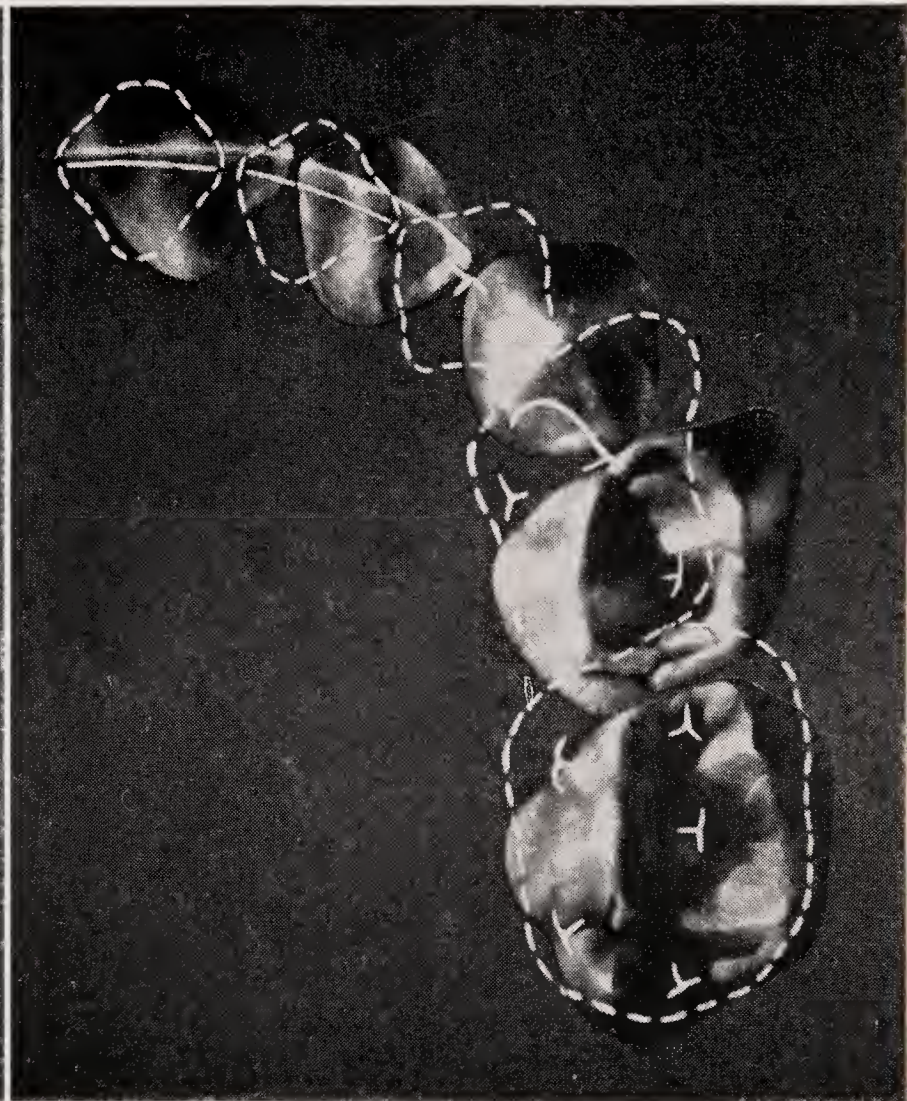


FIGURE 4

Drawing of front and side views of arches in occlusion at 13 months showing vertical space in incisor region, normal overlap of maxillary incisors over mandibular incisors, first molar segments only in contact. (From Clinch: Tr. British Society for the Study of Orthodontics, 1932.)



A



B

FIGURE 5

Drawing of morsal surface of mandibular (A) and maxillary (B) deciduous teeth, with outlines of opposing teeth, points, and ridges of cusps, at 3 years of age.

the incisal area, compared to the mandibular arch, insures that the maxillary incisors are labial to the mandibular incisors when they erupt (Fig. 4). In the molar region, the morphologic characteristics of the molar teeth help to guide the teeth into their correct occlusion. The distal two-thirds of the occlusal surface of the mandibular first molar is occupied by a large fossa whose sides are very steep. This tooth erupts first. The maxillary first

molar erupts facing downward, backward, and outward so that the most prominent cusp is the mediolingual. If it engages any part of the fossa of the mandibular tooth, it is bound to be guided into its correct position as the tooth erupts and then changes its inclination to a more vertical direction.

The same occurs with the second molars. The occlusal surface of the mandibular

tooth is one large fossa. The most prominent cusp of the maxillary tooth as it erupts is the mediolingual cusp. The "oblique ridge" of the maxillary tooth slides down the distal slope of the distobuccal cusp of the mandibular tooth and locks in the distobuccal groove (Fig. 5).

B. The following is a description of the occlusal contacts of the deciduous teeth after their complete eruption at about $2\frac{1}{2}$ to 3 years of age. The scheme is that suggested by Hellman⁹ and slightly modified (in italics): 1, Surface contact; 2, cusp and fossa *or groove or division between two teeth* contact; 3, ridge and groove contact; and 4, ridge and embrasure contact.

1. *Surface Contact*.—The lingual surfaces of the maxillary incisors and canines overlap the labial surfaces of the mandibular incisors and canines and the medial third of the mandibular first molars.

2. *Cusp Point Contact With a Fossa, Groove, or Division Between Two Teeth*.—The lingual cusp of the maxillary first molar occludes in the distal, or main, fossa of the mandibular first molar. (The small distolingual cusp of the maxillary first molar, where present, occludes in the division between the mandibular first and second molars).

The mediolingual cusp of the maxillary second molar occludes in the central fossa of the mandibular second molar.

The distolingual cusp of the maxillary second molar occludes in the distal groove of the mandibular second molar.

The mediobuccal cusp of the mandibular first molar occludes in the division between the maxillary canine and first molar.

The distobuccal cusp of the mandibular first molar occludes in the central fossa of the maxillary first molar.

The mediobuccal cusp of the mandibular second molar occludes in the medial groove of the maxillary second molar.

The distobuccal cusp of the mandibular second molar occludes in the central fossa of the maxillary second molar.

The distal cusp of the mandibular second

molar occludes in the distal groove of the maxillary second molar.

3. *Ridge Contact With Embrasure*.—The triangular ridge of the distobuccal cusp of the maxillary first molar occludes in the embrasure between the mandibular first and second molars. (The triangular ridges of the mediolingual cusps of the mandibular molars have no contact with the sides of the embrasures which they oppose).

4. *Ridge Contact With Groove*.—The triangular ridge of the mediobuccal cusp of the maxillary first molar occludes in the buccal groove of the mandibular first molar.

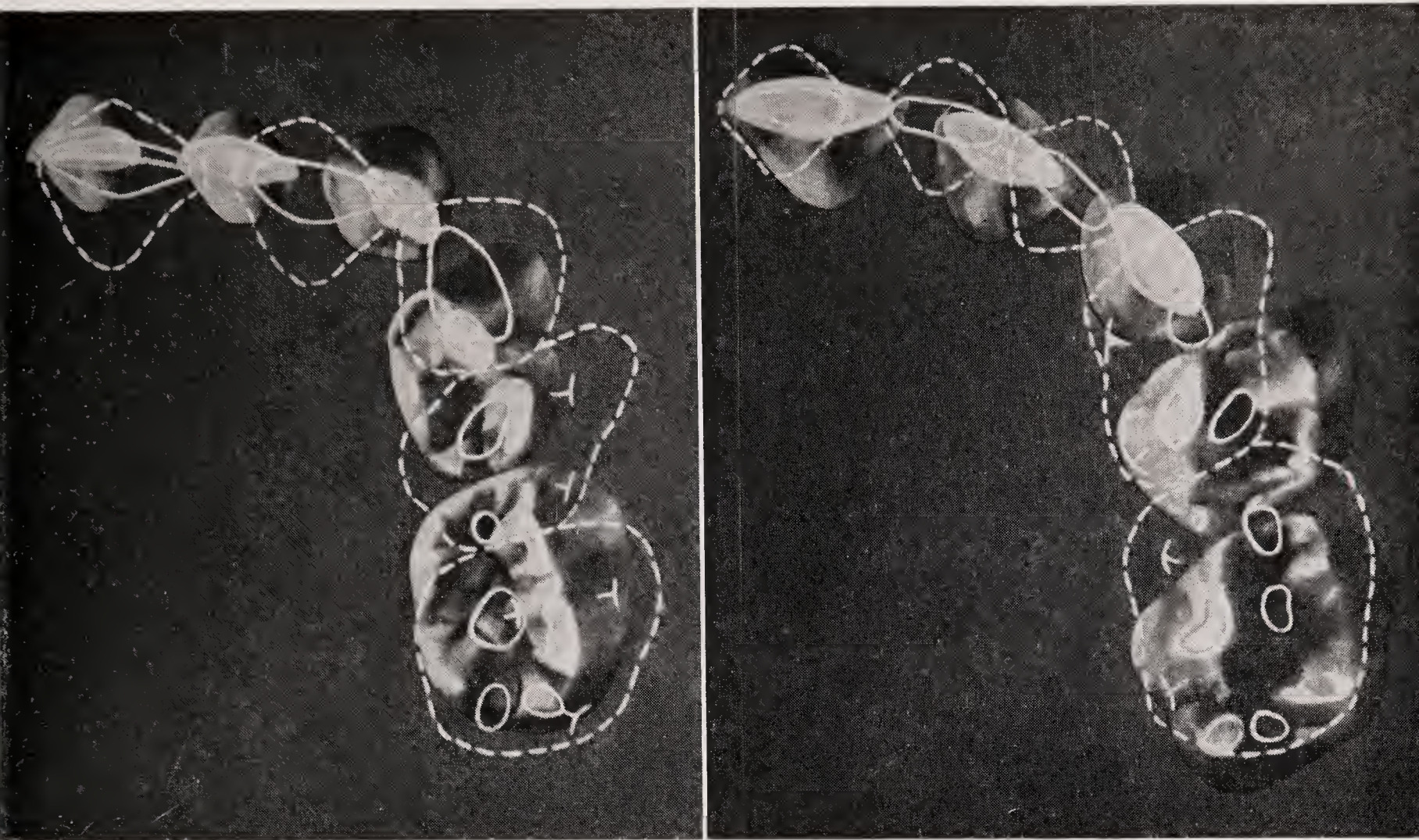
The triangular ridge of the mediobuccal cusp of the maxillary second molar occludes in the buccal groove of the mandibular second molar.

The triangular ridge of the distolingual cusp of the mandibular first molar occludes in the lingual groove of the maxillary first molar where the distolingual cusp is present in the maxillary first molar.

The triangular ridge of the distolingual cusp of the mandibular second molar occludes in the lingual groove of the maxillary second molar.

The continuation of the marginal ridge, distally and buccally, of the mediolingual cusp to join the triangular ridge of the distobuccal cusp, together forming the "oblique ridge" of the maxillary second molar, occludes in the coronal portion of the distobuccal groove of the mandibular second molar.

There are several points of interest to be noticed in the deciduous occlusion, both in the arrangement of the teeth in the arch and in the relative size of the second molars. Baume¹⁰ has pointed out that an "anthropoid" space exists medial to the maxillary canine and distal to the mandibular canine. This has been confirmed by Miss Clinch.¹¹ As long ago as 1908, Chapman¹² was the first to notice that the distal surfaces of the maxillary and mandibular second deciduous molars ended off flush and that some adjustment



A

B

FIGURE 6

Drawing of morsal surface of mandibular (A) and maxillary (B) deciduous teeth, with outlines of opposing teeth, points and ridges of cusps, at 6 years of age showing attrition of incisors, canine and buccal cusps of molars. The relationship of the arches has changed, the mandibular teeth being positioned more medial than at 3 years of age.

must take place to insure that the first permanent molars occlude correctly when they erupt. The mandibular second deciduous molar is larger mediolaterally than the maxillary second deciduous molar, and this is the reason they end off-flush at their distal surfaces when in occlusion.

There is a greater difference in the size of the maxillary permanent incisors compared to their deciduous predecessors than there is of the mandibular permanent incisors and their predecessors. Seipel¹³ gives the average mediolateral diameter of the incisors as maxillary deciduous, 24.12 mm., permanent, 31.30 mm., a difference of 7.18 mm.; mandibular deciduous, 18.22 mm., permanent 23.28 mm., a difference of 5.06 mm. This shows that there must be a greater increase of 2.12 mm. in the maxillary arch than in the mandibular

arch to accommodate the permanent incisors.

These two factors, the flush end of the distal surfaces of the maxillary and mandibular second deciduous molars and the greater increase of the maxillary arch compared to the mandibular arch, are changed by a greater forward movement of the mandibular arch. The forward positioning of the mandibular arch enables it to occlude correctly with the larger maxillary arch (Fig. 6).

It is necessary to examine the position of the permanent incisors at 5 years of age to see what changes must take place to insure their correct alignment when they erupt (Fig. 7).

In 369 radiographs of children from 3 to 6 years of age, 85.7 per cent showed the maxillary permanent lateral incisors lying

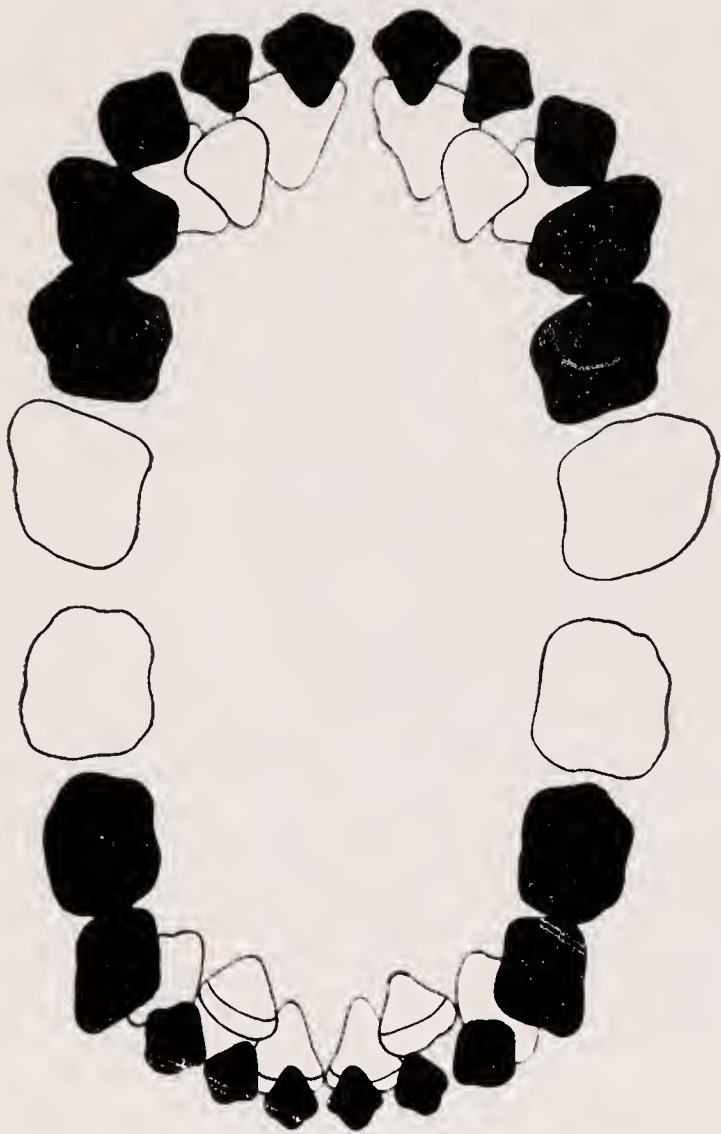


FIGURE 7

Relative positions of permanent incisors, canines, and first permanent molars at 5 years of age.

Note. Permanent incisors lie lingual to deciduous incisors. The lateral incisors overlap lingually the central incisors. The permanent canines are buccal to the laterals, but are farther vertically from the occlusal plane. The maxillary centrals are separated due to the septum and the anterior palatine foramen.

lingual to and partially overlapped by the central incisors. The lateral incisors were lying labial to the centrals in 14.3 per cent, on either one side or both sides (Fig. 8). It is doubtful if many of these latter cases could have a regular alignment of the permanent incisors when they erupt.

There apparently are two processes at work by which room is made for the larger permanent incisors. The first process, bone growth, is manifest in two different ways or a combination of two ways. In one group there is a root and crown spacing; in the second group, a root spacing only, and in the third, a combination of both types. In each, there is an increase in the size of the alveolar arches (Figs. 9 and 10). Miss Clinch¹¹ has shown in the measurements of serial models of the same children an increase in breadth between the deciduous canines. She has shown also a very slight increase in length from the distal surfaces of the second deciduous molars to the centre of the papilla between the central incisors. Miss Clinch very kindly carried out some further measurements for me on the same models (the angle of the labial surface of the maxillary deciduous central incisor to the incisor—second deciduous molar plane). She found that this angle increases with age, that is, the apex moves

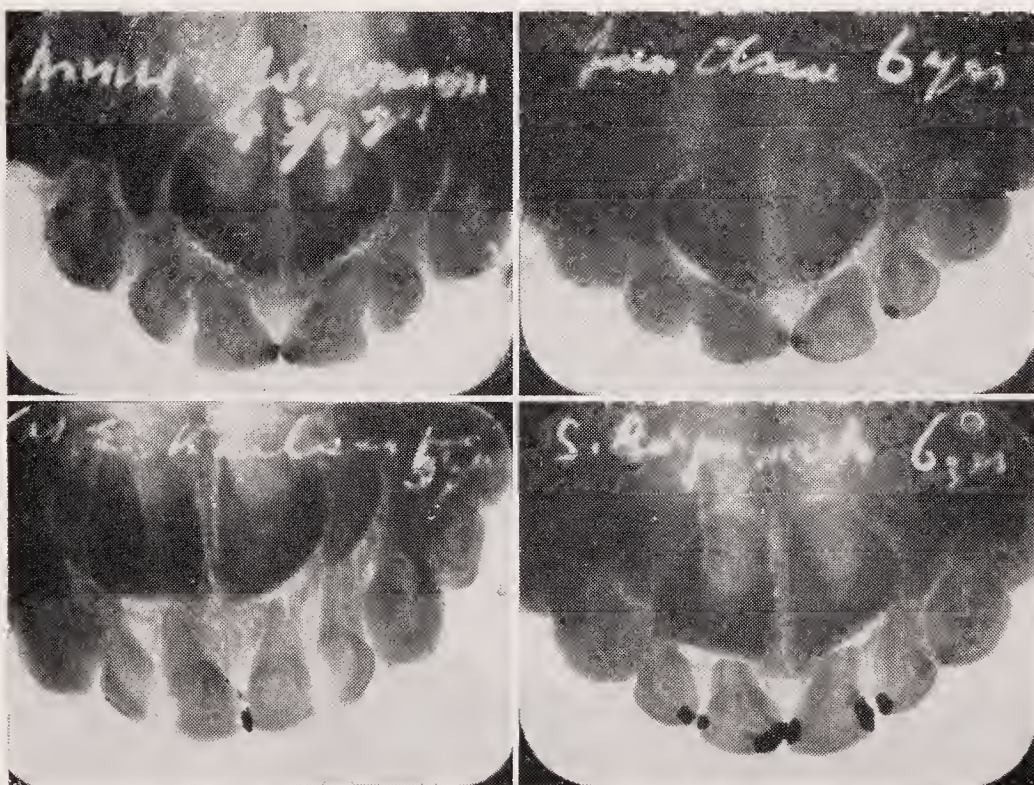


FIGURE 8

Occlusal radiograph showing the lateral incisors rotated and labial to the central incisors, unilateral or bilateral.

labially (Table II). As the incisors are set in a segment of a circle, if the apices of the roots move labially and the incisal angle remain together they must diverge.

The second process is the direction of eruption of the permanent incisors. They are coming downward and forward, so that the incisal edge of each tooth is more labial than the incisal edge of the deciduous incisor. As the centrals erupt they expose their narrower neck to the crowns of the lateral incisors and these are able to escape from their position lingual to and

partly overlapped by the centrals and to erupt downward and forward (Figs. 11 and 12).

It is the normal condition for the maxillary permanent central incisors to be spaced when they erupt. They develop spaced, probably because of the septum between the two halves of the maxilla. The eruption of the lateral incisors usually closes this space.

I mentioned before that a forward movement of all the mandibular deciduous teeth in relation to the maxillary teeth is

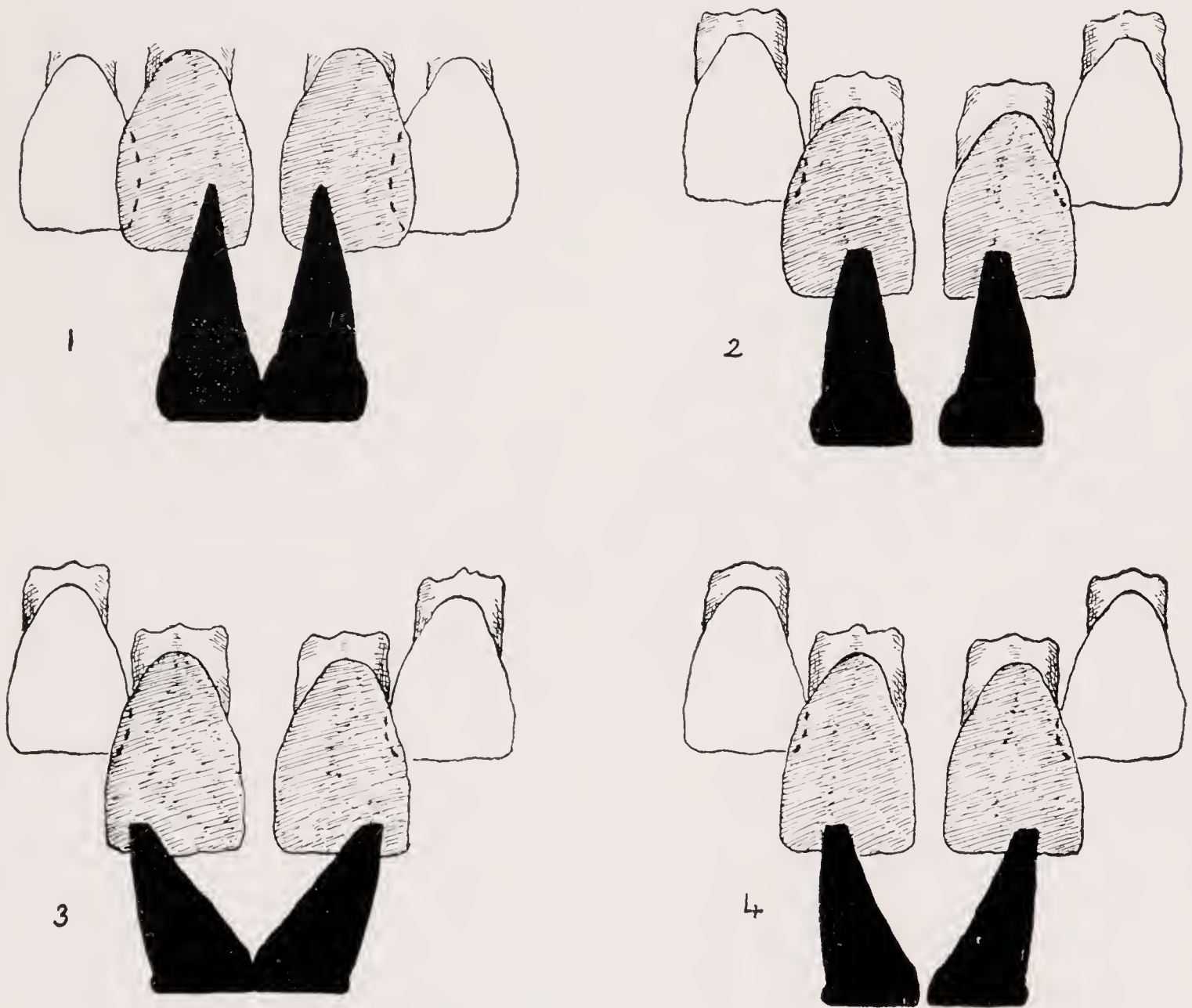


FIGURE 9

Relative positions of maxillary deciduous central incisors and permanent central and lateral incisors as viewed from in front, showing different changes that may occur from 2½ to 5 years of age.

1, 2½ years of age. Roots of deciduous central incisors nearly parallel, little or no spacing at medial incisal angles.

2, 5 years of age. Roots of deciduous central incisors parallel, large spaces between medial incisal angles.

3, 5 years of age. Roots of deciduous central incisors diverging, little or no spacing at medial incisal angles.

4, 5 years of age. Roots of deciduous central incisors diverging and spacing between medial incisal angles.

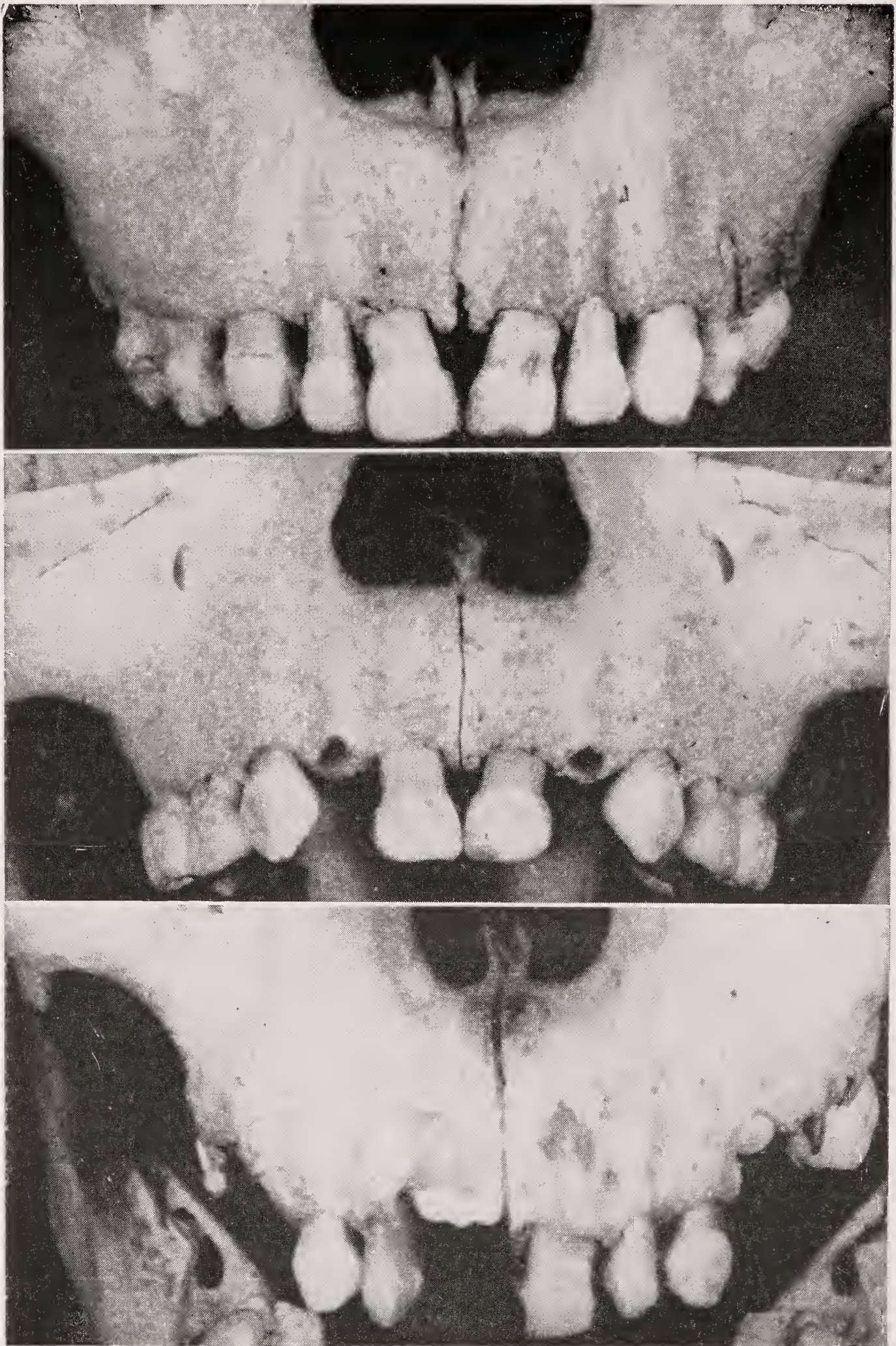


FIGURE 10

Skulls showing root spacing of deciduous central incisors. Ages approximately 4, 5, and 6 years. A, From Anatomical Department, Trinity College, Dublin. B and C from the Anatomical Department, Royal College of Surgeons in Ireland.

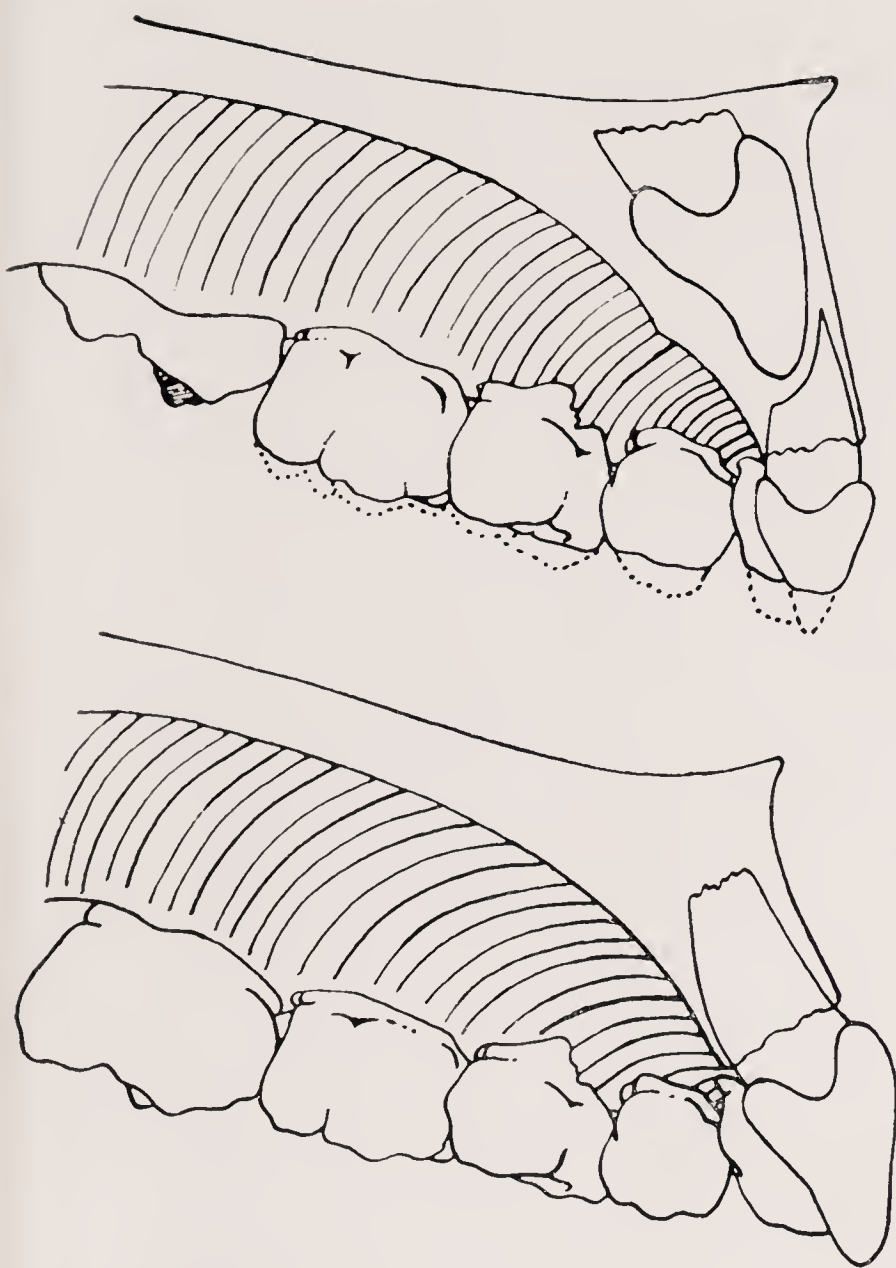


FIGURE 11

The direction of eruption of the maxillary permanent incisors downward and forward automatically brings the crowns of the permanent incisors in a more forward arc of a circle and helps to make room for these larger teeth.

necessary in order that there should not be an apparent protrusion of the maxillary permanent incisors and that the flush ending of the second deciduous molars should not remain. This makes it necessary for the cusps of the teeth, especially the deciduous canines, to be worn down and also that there should be a greater increase in the maxillary intercanine breadth to allow the mandibular teeth to move forward (Fig. 13, A). Wear and increase in width do not mean that the mandibular teeth will move forward; there must be the urge to do so but, unless wears occurs, this alteration in arch relationship *cannot* take place.

Miss Clinch¹¹ has shown this forward

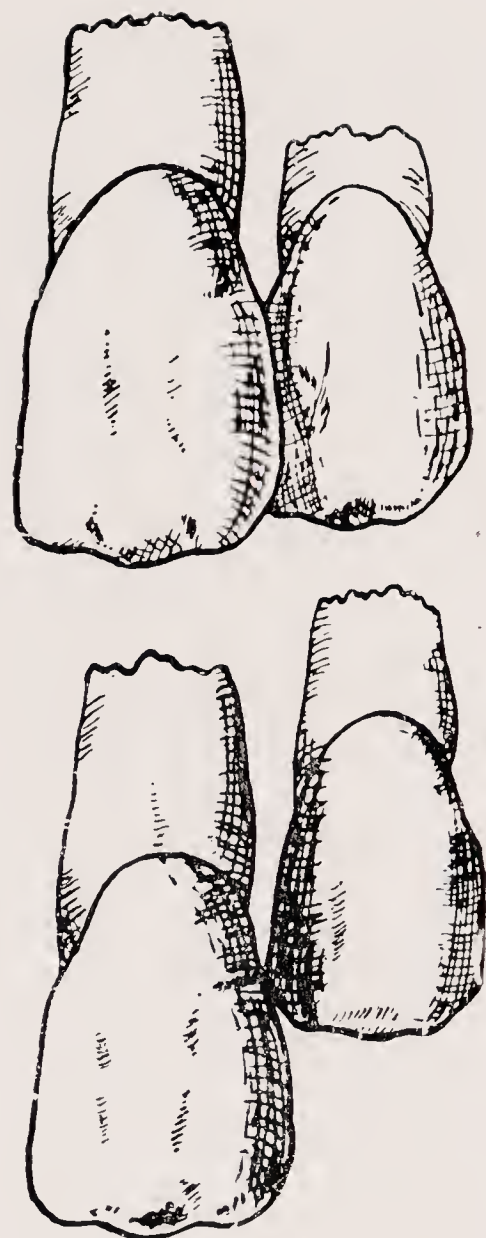


FIGURE 12

Method of escape of maxillary lateral incisors from behind the central incisors. As the central incisor erupts it presents its neck, so that the lateral incisor is able to escape and erupt downward and forward.

movement in her serial models without any appreciable closure of the "anthropoid" spaces described by Baume.¹⁰ That this change of occlusion is vital is evidenced by the rotation of the maxillary first molars and the crowding of the incisors where it has not taken place. The actual change is in the region of 2 mm., but varies a good deal with the size of the mandibular second deciduous molars (Fig. 13, B, C, and D).

C. Up to this stage it has been necessary to obtain increased space for the permanent teeth, but now too much room is provided for the permanent canines and premolars, especially in the mandibular arch (Fig. 14). In the maxilla the extra space, after the loss of the deciduous

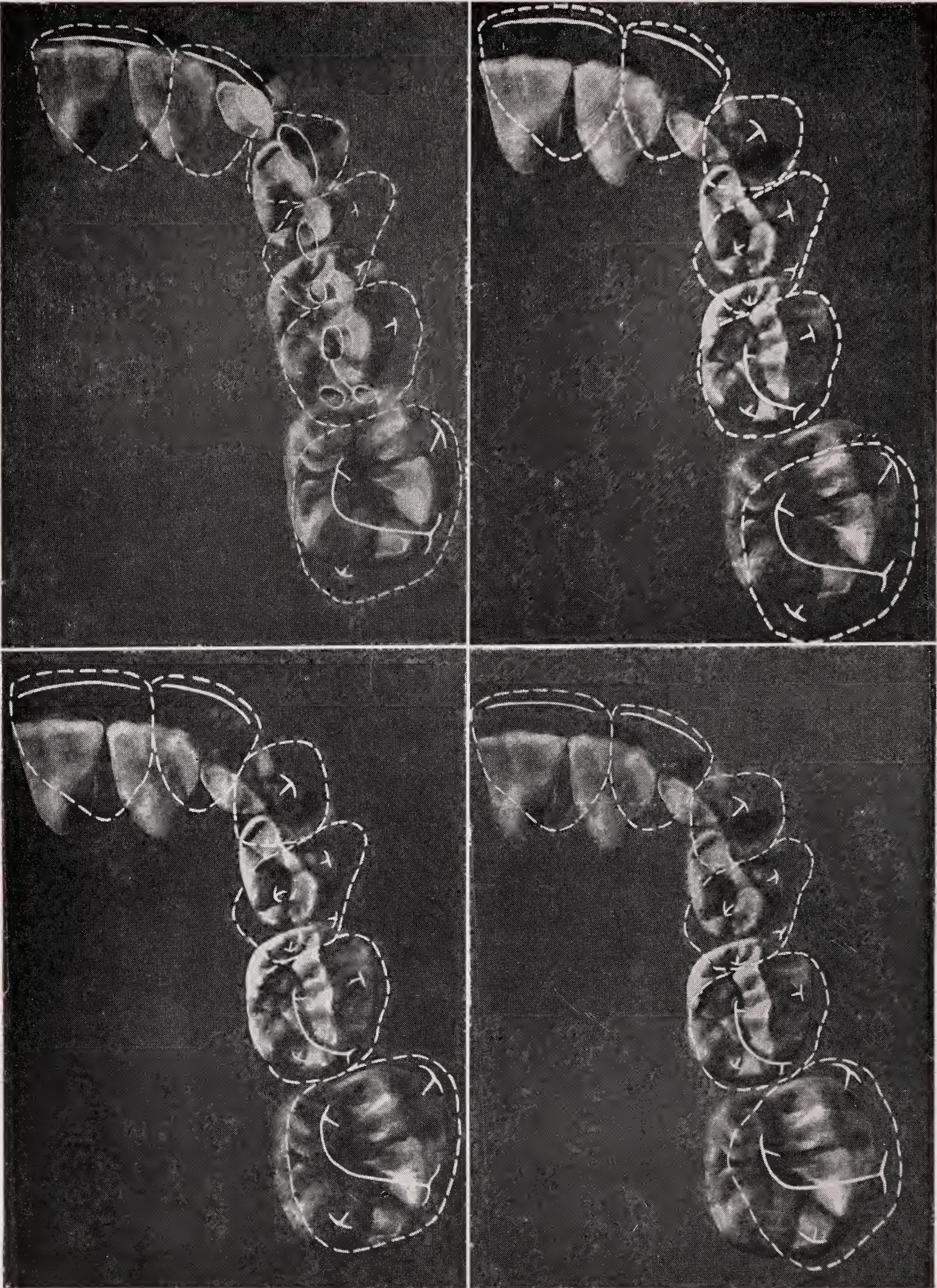


FIGURE 13

FIGURE 13 (opposite)

A, Drawing of morsal surface of mandibular permanent incisors and first permanent molar, deciduous canine, and first and second deciduous molars with outlines of opposing teeth, points and ridges of cusps. Eight years of age. Showing further medial positioning of mandibular arch in relation to maxillary arch.

B, Drawing of morsal surface of mandibular permanent incisors and first permanent molar, deciduous canine and first and second deciduous molars with outlines of opposing teeth, points and ridges of cusps. Eight years of age. No medial positioning of mandibular arch in relation to maxillary arch. No wear of cusps and not sufficient increase in breadth. The distal surfaces of the second deciduous molars end off in the same vertical plane. Should the first permanent molars occlude correctly, a space would be present between the maxillary second deciduous molar and first permanent molar.

C, Similar to former, except that the cusps of the first permanent molars are very flat. The maxillary molar is in contact with the second deciduous molar, but all cusps are in wrong occlusion.

D, Similar to former, except that the maxillary first permanent molar has rotated medio-lingually and is in contact with maxillary second deciduous molar.

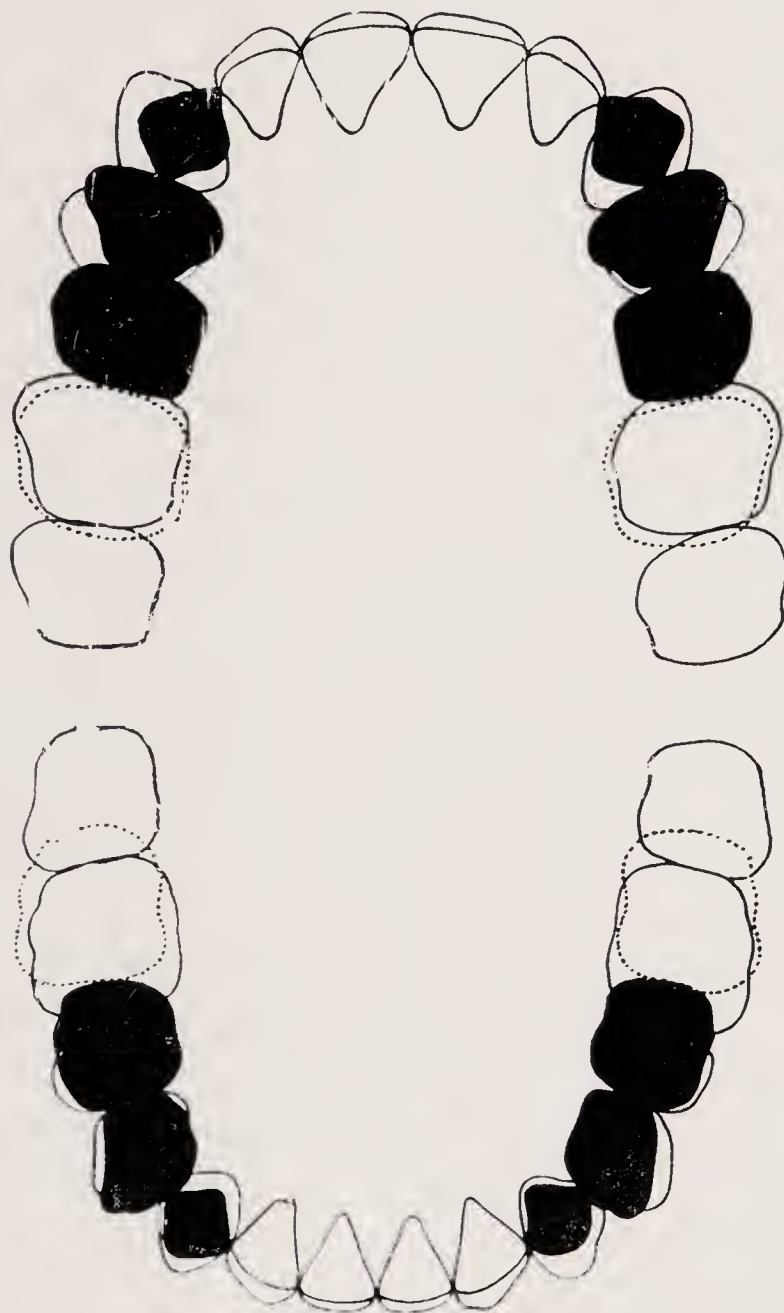


FIGURE 14

Diagram showing too much space provided for the permanent canine and first and second premolars after the loss of the deciduous predecessors, especially in the mandibular arch. The extra space is closed in the mandibular arch by the larger canine and medial drift of first permanent molar. The whole of the extra space in the maxillary arch is not closed, a space remaining between the canine and lateral incisor.

molars and canines, does not completely close. A small space remains between the canine and lateral incisor, a persistence of the "anthropoid" space (Fig. 15). The rest of the space is closed by the larger permanent canine and the forward drift of the first permanent molar, but in the mandibular arch, where there is more extra space, this is completely closed by the permanent canine and a greater forward movement of the first permanent molar. This means that the relationship of the first permanent molars changes, the mandibular molar being farther forward than at 7 to 8 years of age in its relationship to the maxillary molar (Fig. 16). This is an essential movement so that the second permanent molars can occlude correctly (Fig. 17).

The morphology of the first and second

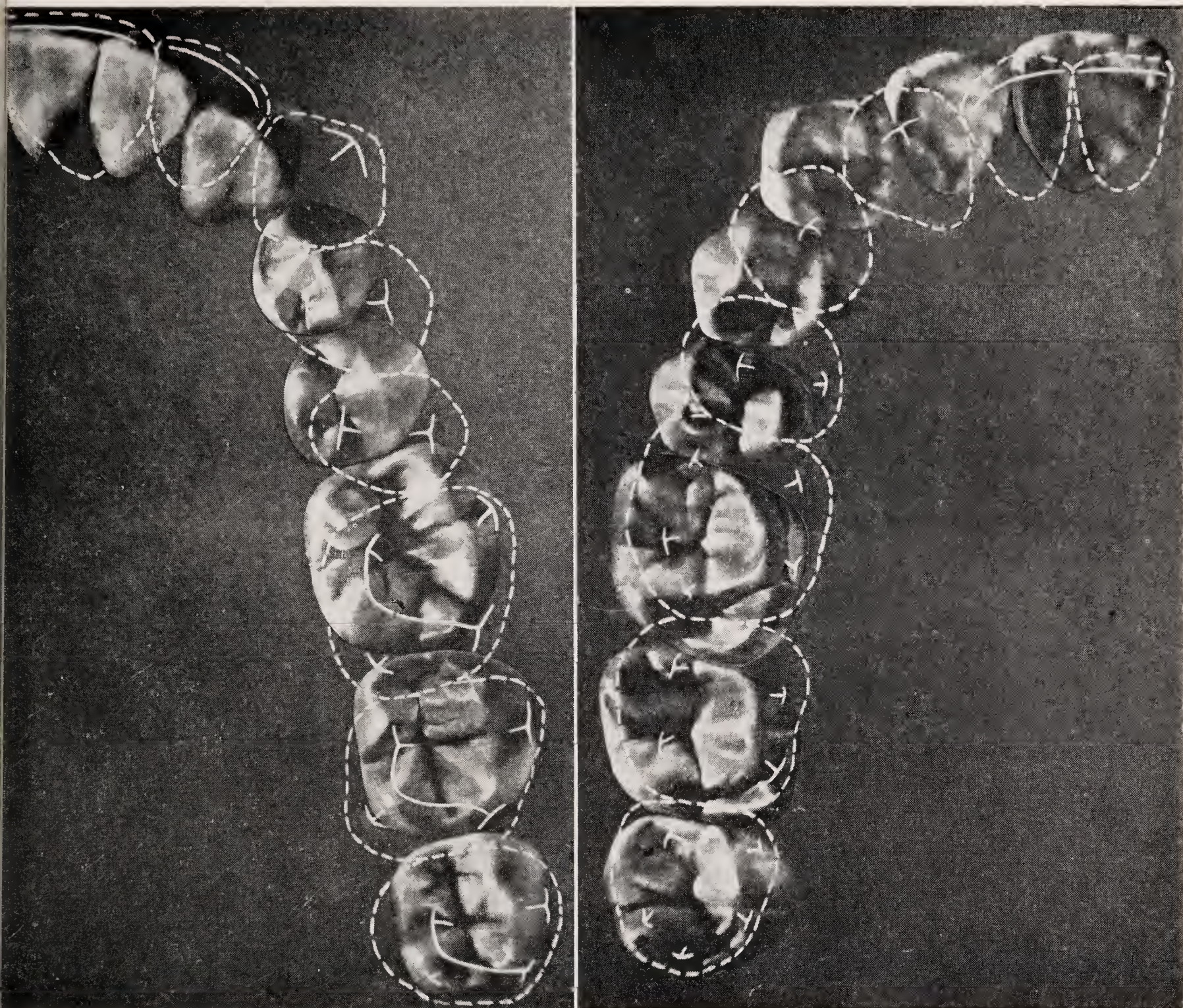
molars is somewhat different. In the maxillary first molar the ridge running lingually from the point of the mediobuccal cusp runs distolingually and it is the centre of this ridge that occludes in the buccal groove of the mandibular first permanent molar; consequently, the point of the cusp is anterior to the buccal groove at 7 to 8 years of age. After the loss of the deciduous molars, the point of the cusp is opposite the buccal groove of the mandibular tooth.

In the maxillary second molar the ridge running lingually from the point of the mediobuccal cusp runs more directly lingually, not distolingually, so that when the ridge occludes in the buccal groove of the mandibular tooth, the cusp point is opposite the groove (Fig. 18).



FIGURE 15

Skull showing the space remaining between the maxillary lateral incisor and canine. (Courtesy of Prof. Dr. Med. K. E. Schreiner, Anatomical Institute, University of Oslo.)



A.

B.

FIGURE 16

Drawing of morsal surface of mandibular (A) and maxillary (B) permanent teeth with outlines of opposing teeth, points and ridges of cusps. Young adult.

THE OCCLUSION OF THE PERMANENT TEETH OF A YOUNG ADULT*

A. Surface Contact.—The lingual surfaces of the maxillary incisors and canines overlap from one-fourth to one-third of the labial surface of the mandibular incisors and canines and the medial half of the first premolars.

B. Cusp Point Contact With a Fossa or Groove or Division Between Two Teeth.—The lingual cusp¹⁴ of the maxillary first

premolar occludes on the buccal side of the distal fossa of the mandibular first premolar.

The lingual cusp¹⁴ of the maxillary second premolar occludes in the distal fossa of the mandibular second premolar.

The mediolingual cusp of the maxillary first molar occludes in the central fossa of the mandibular first molar.

The mediolingual cusp of the maxillary

*The italics denote changes from the occlusion published by the First International Orthodontic Congress, New York, August, 1926.

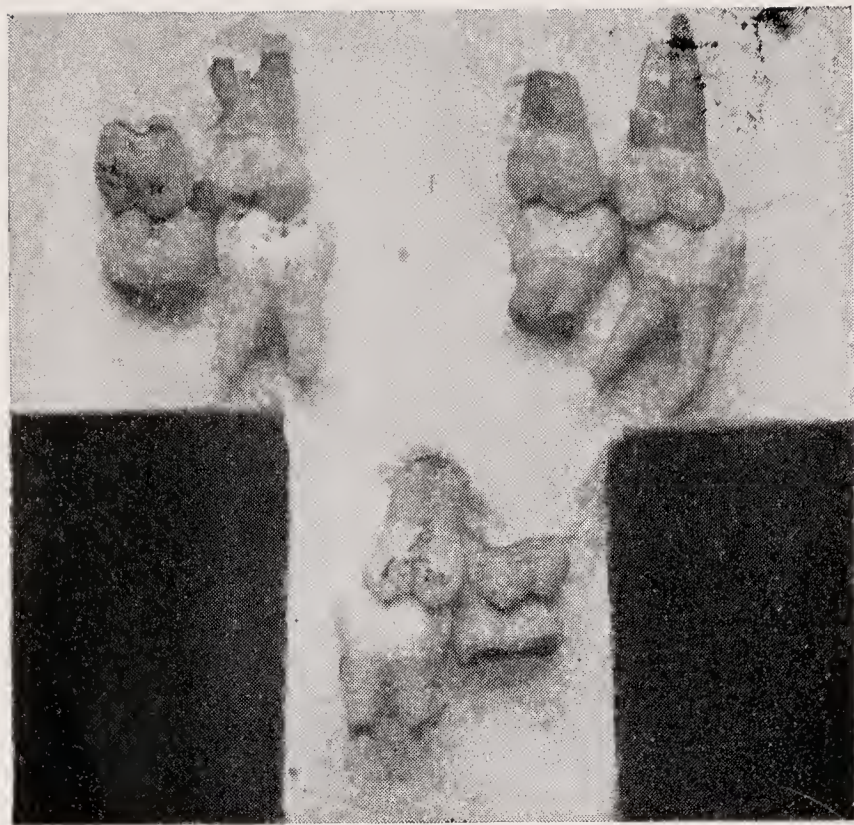


FIGURE 17

First and second molars removed from three skulls. The first molars are occluded as at 8 years of age, the second molars in their correct relationship. In each case a space remains between the maxillary molars, showing that it is necessary for the mandibular first molar to move more medially than the maxillary first molar subsequent to the loss of the deciduous molars.

second molar occludes in the central fossa of the mandibular second molar.

The mediolingual cusp of the maxillary third molar occludes on the lingual side of the central fossa of the mandibular third molar.

The distolingual cusp of the maxillary first molar occludes slightly on the lingual side of the distal groove of the mandibular first molar and mainly in the medial groove of the mandibular second molar.

The distolingual cusp of the maxillary second molar occludes on the lingual side of the distal groove or fossa of the mandibular second molar.

The distolingual cusp of the maxillary third molar occludes on the lingual side of the distal fossa of the mandibular third molar.

The buccal cusp of the mandibular first premolar occludes in the division between the maxillary canine and first premolar.

The buccal cusp of the mandibular second premolar occludes in the division



FIGURE 18

Same skull as Fig. 15, but viewed at right angles to the molar teeth. Showing the mandibular first molar slightly more medial in relation to the maxillary molar than at 8 years of age. Second molars occluding correctly.

between the maxillary first and second premolars; point of cusp is in the medial groove of maxillary second premolar.

The mediobuccal cusp of the mandibular first molar occludes in the division between the maxillary second premolar and first molar.

The mediobuccal cusp of the mandibular second molar occludes in the division between the maxillary first and second molars, or in the medial groove of the maxillary second molar.

The mediobuccal cusp of the mandibular third molar occludes in the medial groove or supplemental medial fossa of the maxillary third molar.

The distobuccal cusp of the mandibular first molar occludes in the *mediobuccal* side of the central fossa of the maxillary first molar.

The distobuccal cusp of the mandibular second molar occludes on the distal side of the central fossa of the maxillary second molar.

The distobuccal cusp of the mandibular third molar occludes on the distal side of the central fossa of the maxillary third molar.

The distal cusp of the mandibular first molar occludes on the medial side of the distal fossa of the maxillary first molar.

The distal cusp of the mandibular second molar, when present, occludes in the distal fossa of the maxillary second molar.

The distal cusp of the mandibular third molar, when present, occludes on the medial side of the distal fossa of the maxillary third molar.

C. Ridge Contact With Embrasure.—The triangular ridge of the buccal cusp of the maxillary first premolar occludes in the embrasure between the mandibular first and second premolars; the triangular ridge is slightly medial to the apex of the embrasure.

The triangular ridge of the buccal cusp

of the maxillary second premolar occludes in the embrasure between the mandibular second premolar and first molar; the triangular ridge is medial to the apex of embrasure.

The triangular ridge of the distobuccal cusp of the maxillary second molar occludes in the embrasure between the mandibular second and third molars, where the mandibular second molar is a four-cusped tooth; usually the triangular ridge is slightly medial to the apex of embrasure, so that there is little or no contact with the mediobuccal surface of the mediobuccal cusp of the mandibular third molar.

The triangular ridge of the mediolingual cusp of the mandibular second molar occludes in the embrasure between the maxillary first and second molars; the triangular ridge is slightly distal to the apex of embrasure.

The triangular ridge of the mediolingual cusp of the mandibular third molar occludes in the embrasure between the maxillary second and third molars; the triangular ridge is distal to the apex of embrasure.*

D. Ridge Contact With Groove.—The triangular ridge of the mediobuccal cusp of the maxillary first molar occludes *distal* to the buccal groove of the mandibular first molar. The triangular ridge slopes distolingually from the point of the cusp so that cusp point is *opposite* the buccal groove at this period.

The triangular ridge of the mediobuccal cusp of the maxillary second molar occludes in the buccal groove of the mandibular second molar. The point of the cusp is *opposite* the buccal groove the triangular ridge running *lingually*.

The triangular ridge of the mediobuccal cusp of the maxillary third molar occludes in the buccal groove of the mandibular third molar.

*The triangular ridges of the lingual cusps of the mandibular first and second premolars, and usually the mediolingual cusp of the mandibular first molar, have no contact with the sides of the embrasures which they oppose.

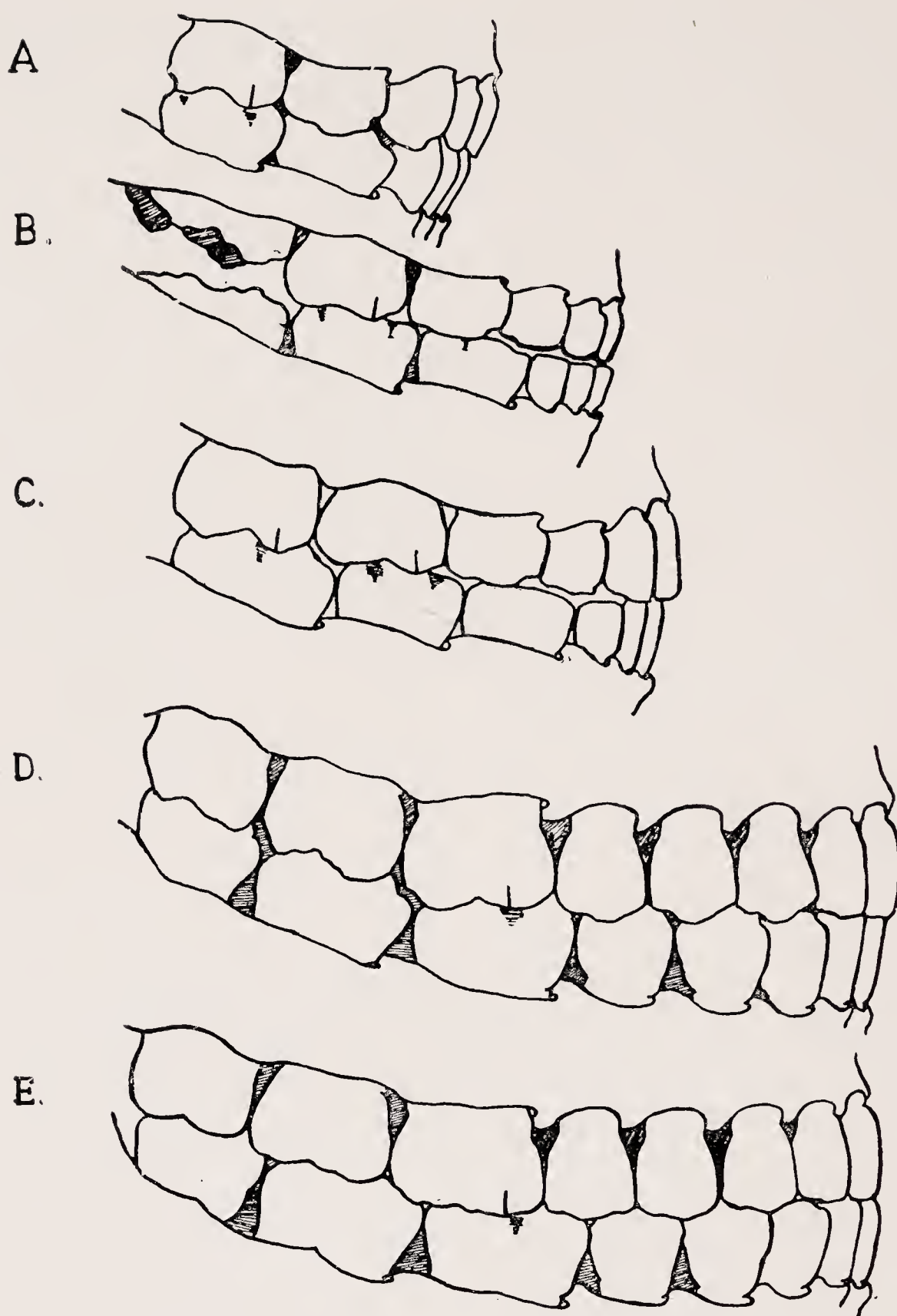


FIGURE 19

A, Stages of occlusion from 3 years of age to old age. At 3 years of age the triangular ridge of the mediobuccal cusp of the maxillary second deciduous molar occludes in the buccal groove of the mandibular second deciduous molar.

B, At $5\frac{1}{2}$ years of age the mandibular arch has moved forward in relation to the maxillary arch so that the buccal groove of the mandibular second deciduous molar is medial to the triangular ridge of the mediobuccal cusp of the maxillary second deciduous molar.

C, At 8 years of age the mandibular arch has moved slightly more forward in relation to the maxillary arch. The permanent incisors and first permanent molar have erupted. The point of the mediobuccal cusp of the maxillary first permanent molar is slightly medial to the buccal groove of the mandibular first permanent molar.

D, Young adult. All the permanent teeth are in occlusion. The point of the mediobuccal cusp of the maxillary first permanent molar is opposite the buccal groove of the mandibular first permanent molar.

E, Old age. Teeth worn. Mandibular teeth in more forward relation to maxillary teeth. Buccal groove of mandibular first permanent molar is medial to mediobuccal cusp point of maxillary first permanent molar. Distobuccal cusp of maxillary first molar is in contact with the mediobuccal cusp of mandibular second molar. Incisors meet edge to edge.

The triangular ridge of the distobuccal cusp of the maxillary first molar occludes *distal* to the distobuccal groove of the mandibular first molar; there is no contact with the mediobuccal cusp of mandibular second molar in unworn teeth.

The triangular ridge of the distobuccal cusp of the maxillary second molar occludes in the distobuccal groove of the mandibular second molar, where the mandibular second molar is a five-cusped tooth.

The triangular ridge of the distobuccal cusp of the maxillary third molar occludes in the distobuccal groove of the mandibular third molar, where the mandibular third molar is a five-cusped tooth.

The continuation of the marginal ridge distobuccally of the mediolingual cusp to join the triangular ridge of the distobuccal cusp of the maxillary first molar, the oblique ridge, occludes *distal* to the coronal portion of the distobuccal groove of the mandibular first molar.

The oblique ridge of the maxillary second molar occludes in the distal groove and the distotriangular groove of the distobuccal cusp of the mandibular second molar, where the mandibular second molar is a four-cusped tooth. (Where the mandibular second molar is a five-cusped tooth, the oblique ridge occludes in the coronal portion of the distobuccal groove).

The oblique ridge of the maxillary third molar occludes in the coronal portion of the distobuccal groove of the mandibular third molar, where the mandibular third molar is a five-cusped tooth. (Where the mandibular third molar is a four-cusped tooth, the oblique ridge occludes in the distal groove and the distotriangular groove of the distobuccal cusp of the mandibular third molar).

The triangular ridge of the distolingual cusp of the mandibular first molar occludes in the lingual portion of the distolingual groove of the maxillary first molar.

The triangular ridge of the distolingual

cusp of the mandibular second molar occludes in the lingual portion of the distolingual groove of the maxillary second molar.

The triangular ridge of the distolingual cusp of the mandibular third molar occludes in the lingual portion of the distolingual groove of the maxillary third molar.

E. The last major change that occurs in the occlusion of the permanent teeth is the result of wear—wear of the cusps and interproximal wear. The wear of the cusps shortens the height of the teeth so that in occlusion the mandible swings farther up, and consequently forward, and the incisors meet edge to edge. The interproximal wear appears to reduce the mediobuccal diameters of the maxillary and mandibular teeth, so that the length of the arches decreases.

It is evident from this description of ideal occlusion that the relationships of the teeth, both deciduous and permanent, are always changing, and it is a knowledge of these changes that is so important in diagnosing malocclusion (Fig. 19). It all may be a myth and a figment of my imagination, but I feel that a knowledge of the myth is a great help.

PART II. EVIDENCE IN SUPPORT OF PART I

There are two methods of investigation of the growth of the jaws and occlusion of the teeth.

The first method, the examination and recording of numbers of the same individuals at different periods of growth, is scientifically sound but takes many years to record. The losses on the way are very great from many causes.

The second method, the examination and recording of different individuals at different ages or periods of growth, gives only an indication of the changes that occur. It is not definite proof. The advantage is that investigations can be carried out in a comparatively short time.

A considerable amount of work has been done by several investigators by the first method (cephalometric radiographs by Broadbent and others, serial models and measurements by Sillman, Miss Clinch, and others), and very definite information has been obtained. Many more investigators have used the second method, on both man and animals. Comparative anatomic studies can be very valuable, but one has to remember that no animal has quite the same make-up as man. Nevertheless, they may give indications that the same thing occurs in man, perhaps to a lesser degree or in a modified form.

It is possible to obtain large numbers of animal skulls with normal occlusion at different periods of growth, but it is difficult, if not impossible, to get the same number of human skulls with normal occlusion.

The investigation that I undertook during the last year was by the second method and was carried out partly on human beings and partly on chimpanzee skulls. The latter gave an indication that certain changes might occur in human beings, and the former that it probably does occur.

There are many difficulties in such investigations. The variation in growth of individuals is very great, the size of the animal and the size of the teeth will vary and, although they all may get the same result, normal occlusion, the statistical analyses of the measurements may not show significant differences between the age groups.

I had two objects in this investigation:

1. To see how room was obtained for the permanent incisor teeth.
2. To see what changes, if any, occurred in the occlusion of the cheek teeth from the time of the eruption of the deciduous teeth to the complete eruption of the permanent teeth.

Chimpanzee skulls were chosen because I thought their teeth were nearer to human teeth than those of any other animal. The difficulty was to find a sufficient number of skulls, and I am very grateful to the authorities of the various museums who gave me every assistance that was possible. There were many disappointments on the way, chiefly teeth having dropped out of sockets post-mortem and being lost, that made some skulls of no use for my measurements.

Two hundred fourteen skulls were divided into the following seven groups.

- I. Deciduous teeth only—26 skulls.
- II. Deciduous teeth and first permanent molars—47 skulls.
- III. Permanent incisors, deciduous molars and canines, and first and second permanent molars—27 skulls.
- IV. Young adult (slight wear)—35 skulls.
- V. Adult (medium wear)—29 skulls.
- VI. Adult (marked wear)—28 skulls.
- VII. Adult (excessive wear)—22 skulls.

The observations and measurements recorded to try and discover how room was made for the permanent incisors were:*

Teeth present.

Attrition.

Length of maxillary arch from the distal surfaces of the second deciduous molars or second premolars to the midalveolar point between the central incisors (I).

Length of mandibular arch from the distal surfaces of the second deciduous molars or second premolars to the midalveolar point between the central incisors (K).

Length of maxillary arch from the distal surfaces of the second deciduous molars or second premolars to the labial

*The capital letters after each measurement refer to the headings of the Tables.

surface of the central incisors near the incisal edge (J).

Length of mandibular arch from the distal surfaces of the second deciduous molars or second premolars to the labial surface of the central incisors near the incisal edge (L).

Breadth of maxillary arch, minimum internal between canines (M).

Breadth of mandibular arch, minimum internal between canines (N).

Breadth of maxillary arch, maximum external between canines (O).

Breadth of mandibular arch, maximum external between canines (P).

Space at alveolar margin between maxillary central incisors (C).

Space at alveolar margin, right and left, between maxillary lateral incisor and canine (DR and DL).

Space at alveolar margin, right and left, between mandibular lateral incisor and canine (ER and EL).

Space between medial incisal angles of maxillary central incisors (F).

Space between contact points, maxillary (right and left) canine and first deciduous molar or first premolar (GR and GL).

Space between contact points, mandibular (right and left) canine and first deciduous molar or first premolar (HR and HL).

Angle of divergency of roots, maxillary central incisors (B).

Angle of labial surface of maxillary central incisors to incisor molar plane (A).

The means of each group, the differences between the means of each group, their standard error, and whether the differences are sufficient to be statistically significant are given. A significant difference is real, and not due to chance. The measurements are in degrees and in millimeters (Table I).

From these tables it can be seen that the *incisal angles remain together* (F), and the maxillary canine and first deciduous molar or first premolar *are in contact* (G).

The space between contact points, mandibular canine and first deciduous molar or first premolar decreased slightly Groups II to III, but *not significantly*. All other groups increased slightly, but *not significantly* (H).

Significant increase in space between maxillary incisors and between incisors and canines at alveolar margin was found in Groups I to II, II to III, and a *not significant increase* in Groups III to IV except on the right side between the lateral incisor and canine, which increase was *significant* (C and D).

There was a *significant increase* between the mandibular lateral incisor and canine at the alveolar margin, Groups I to II and II to III (E).

There was a *significant increase* of angle of labial surface of the maxillary deciduous central incisor to the incisor molar plane, Groups I to II, and a *significant decrease* of the angle of permanent central incisor to the incisor molar plane, Groups II to III, and again a *significant increase*, Groups III to IV, IV to V, and VI to VII (A).

There was a *significant increase* of length of maxillary arch to midalveolar point, Groups II to III, and III to IV. The increases between the other groups were *not significant* (I).

Significant increase of length of maxillary arch to labial surface of central incisors was found in Groups II to III, and III to IV. The increases, Groups I to II, and IV to V, were *not significant*. There was a decrease, Groups V to VI, and VI to VII, but it was *not significant* (J).

There was a *significant increase* of length of mandibular arch to midalveolar point, Groups III to IV. There was *not a significant increase* between any other groups, and a slight decrease between Groups V and VI (K).

There was a *significant increase* of length of mandibular arch to labial surface of central incisors, Groups I to II, II to III, and III to IV (L).

TABLE I

GROUP	NUMBER IN GROUP	MEAN (MILLIMETERS)	GROUP	INCREASE IN MEANS (MILLIMETERS)	STANDARD ERROR
<i>Figure A</i>					
I	25	74.48°	I to II*	5.42°	1.29
II	43	79.90°	II to III*	-7.79°	1.25
III	27	72.11°	III to IV*	4.96°	1.37
IV	35	77.07°	IV to V*	3.26°	1.45
V	29	80.33°	V to VI	3.27°	1.69
VI	28	83.60°	VI to VII*	8.83°	2.47
VII	14	92.43°			
<i>Figure B</i>					
I	24	14.69°	I to II	2.98°	2.24
II	41	17.67°	II to III*	-15.04°	1.47
III	27	2.63°	III to IV*	4.23°	1.31
IV	35	6.86°	IV to V	-1.54°	1.51
V	28	5.32°	V to VI*	5.16°	1.93
VI	28	10.48°	VI to VII	6.19°	3.13
VII	18	16.67°			
<i>Figure C</i>					
I	24	2.34	I to II*	0.44	0.20
II	44	2.78	II to III*	0.48	0.22
III	26	3.26	III to IV	0.32	0.20
IV	35	3.58	IV to V	0.10	0.22
V	27	3.68	V to VI	-0.01	0.28
VI	26	3.67	VI to VII*	-0.71	0.32
VII	18	2.96			
<i>Figure DR</i>					
I	17	3.02	I to II*	2.01	0.37
II	33	5.03	II to III*	-1.64	0.36
III	23	3.39	III to IV*	1.34	0.45
IV	31	4.73			
<i>Figure DL</i>					
I	17	2.99	I to II*	2.08	0.39
II	30	5.07	II to III*	-1.66	0.47
III	23	3.41	III to IV	1.00	0.00
IV	32	4.41			
<i>Figure ER</i>					
I	16	1.52	I to II*	1.49	0.28
II	33	3.01	II to III*	-1.29	0.30
III	23	1.72	III to IV	0.21	0.30
IV	31	1.93			
<i>Figure EL</i>					
I	17	1.54	I to II*	1.49	0.26
II	34	3.03	II to III*	-1.41	0.35
III	22	1.62	III to IV	0.43	0.36
IV	33	2.05			
<i>Figure F</i>					
I	24	0.04	I to II	0.07	0.08
II	43	0.11	II to III	-0.05	0.09
III	27	0.06	III to IV	0.05	0.09
IV	33	0.11	IV to V	-0.03	0.10
V	28	0.08	V to VI	0.05	0.12
VI	25	0.13	VI to VII	0.17	0.19
VII	14	0.30			

*These increases are significant.

TABLE I—CONT'D.

GROUP	NUMBER IN GROUP	MEAN (MILLIMETERS)	GROUP	INCREASE IN MEANS (MILLIMETERS)	STANDARD ERROR
<i>Figures GR and GL</i>					
No significant increase between any groups.					
90.87 per cent had no space out of 383 measurements.					
9.13 per cent had a space averaging 1.4 mm.					
<i>Figure HR</i>					
I	18	0.92	I to II	0.28	0.20
II	41	1.20	II to III	-0.06	0.17
III	22	1.14	III to IV*	0.54	0.24
IV	31	1.68	IV to V	0.04	0.28
V	28	1.72	V to VI	0.28	0.22
VI	26	2.00	VI to VII	0.43	0.30
VII	19	2.43			
<i>Figure HL</i>					
I	21	0.95	I to II	0.25	0.17
II	41	1.20	II to III	-0.01	0.20
III	21	1.19	III to IV	0.32	0.26
IV	32	1.51	IV to V	0.09	0.24
V	29	1.60	V to VI	0.37	0.20
VI	26	1.97	VI to VII	0.33	0.26
VII	19	2.30			
<i>Figure I</i>					
I	24	30.03	I to II	0.43	0.53
II	38	30.46	II to III*	2.10	0.64
III	22	32.56	III to IV*	2.37	0.83
IV	30	34.93	IV to V	0.71	0.78
V	27	35.64	V to VI	0.46	0.69
VI	21	36.10	VI to VII	0.24	0.80
VII	16	36.34			
<i>Figure J</i>					
I	25	34.22	I to II	0.45	0.58
II	36	34.67	II to III*	5.18	0.75
III	22	39.85	III to IV*	2.20	0.87
IV	30	42.05	IV to V	0.83	0.94
V	27	42.88	V to VI	-0.57	0.87
VI	21	42.31	VI to VII	-1.33	1.03
VII	13	40.98			
<i>Figure K</i>					
I	25	28.06	I to II	0.57	0.47
II	37	28.63	II to III	0.62	0.49
III	22	29.25	III to IV*	2.56	0.57
IV	29	31.81	IV to V	0.78	0.52
V	26	32.59	V to VI	-0.08	0.54
VI	20	32.51	VI to VII	0.35	0.61
VII	16	32.86			
<i>Figure L</i>					
I	24	31.87	I to II*	1.15	0.48
II	34	33.02	II to III*	3.63	0.64
III	22	36.65	III to IV*	2.65	0.71
IV	28	39.30	IV to V	0.57	0.64
V	26	39.87	V to VI	-0.23	0.66
VI	19	39.64	VI to VII	-0.91	0.88
VII	13	38.73			

*These increases are significant.

TABLE I—CONT'D.

GROUP	NUMBER IN GROUP	MEAN (MILLIMETERS)	GROUP	INCREASE IN MEANS (MILLIMETERS)	STANDARD ERROR
<i>Figure M</i>					
I	16	26.75	I to II*	4.62	0.60
II	41	31.37	II to III*	3.95	0.60
III	20	35.32	III to IV	1.15	0.71
IV	29	36.47	IV to V	1.63	0.87
V	27	38.10	V to VI	1.40	0.88
VI	26	39.50	VI to VII	0.49	0.97
VII	16	39.99			
<i>Figure N</i>					
I	18	20.24	I to II*	3.96	0.56
II	43	24.20	II to III*	2.69	0.60
III	19	26.89	III to IV	0.88	0.61
IV	31	27.77	IV to V	0.22	0.62
V	28	27.99	V to VI*	1.50	0.68
VI	25	29.49	VI to VII	0.53	0.81
VII	20	30.02			
<i>Figure O</i>					
I	16	38.14	I to II*	5.02	0.60
II	41	43.16	II to III*	4.70	1.30
III	19	47.86	III to IV*	8.20	1.44
IV	30	56.06	IV to V*	2.50	1.25
V	27	58.56	V to VI	1.76	1.35
VI	26	60.32	VI to VII	-1.51	1.35
VII	14	58.81			
<i>Figure P</i>					
I	18	31.71	I to II*	4.30	0.46
II	43	36.01	II to III*	5.03	0.89
III	19	41.04	III to IV*	6.69	1.13
IV	31	47.73	IV to V	0.87	1.44
V	28	48.60	V to VI	2.14	1.43
VI	25	50.74	VI to VII	-0.46	1.18
VII	19	50.28			

*These increases are significant.

A *significant increase* in breadth of maxillary arch, minimum internal canine to canine, appeared in Groups I to II, and II to III (M).

There was also a *significant increase* in the mandibular breadth minimum internal canine to canine, Groups I to II, II to III, and V to VI (N).

There was a *significant increase* in breadth of maxillary arch, maximum external, canine to canine, Groups I to II, II to III, III to IV, and IV to V. There was also a *significant increase* in mandibular arch breadth, Groups I to II, II to III, and III to IV (O, P).

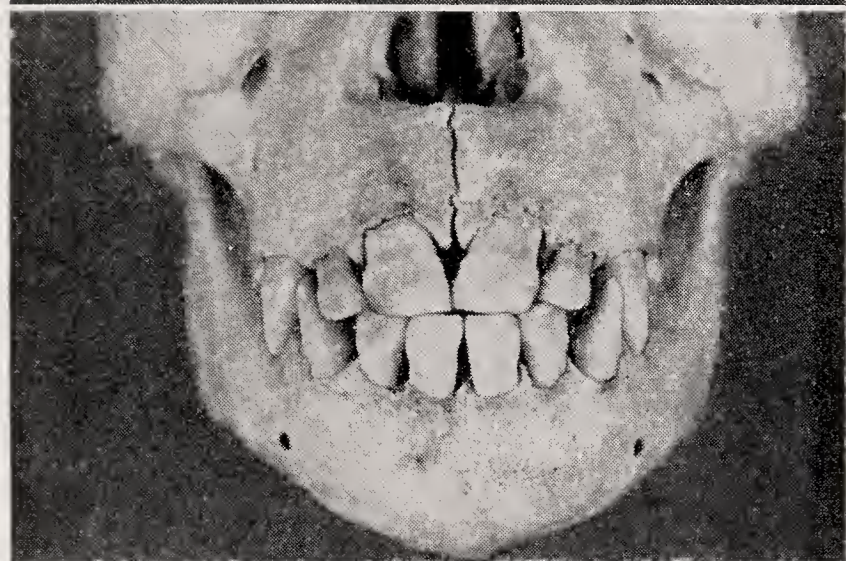
There was *not a significant increase* in the angle of divergency between the roots of the maxillary deciduous central incisors, Groups I to II, although the increase was in the right direction; a *significant decrease*, Groups II to III; and a *significant increase* Groups III to IV, and V to VI, and almost Groups VI and VII (B). These last measurements were surprising and I do not know whether they occur in man (Fig. 20).

Room for the permanent incisors appears to be made by increase in arch breadth, alveolar spacing (the incisal angles remaining in contact), labial tilting of the roots of the deciduous incisors, the

A



B



C



D



FIGURE 20
Chimpanzee skulls.

A, *Deciduous teeth only.*
 B, *Deciduous teeth and first permanent molars.*
 C, *Young adult.*
 D, *Old adult.*
 A, shows little attrition and roots of deciduous centrals nearly parallel; B, divergency of roots of deciduous centrals; C, permanent centrals nearly parallel; D, again divergency of permanent centrals in old age.

(Courtesy of Mrs. Powell-Cotton, The Powell-Cotton Museum, Birchington, Kent).

TABLE II
AVERAGE ANGLE OF LABIAL SURFACE OF MAXILLARY DECIDUOUS CENTRAL INCISOR TO THE INCISOR MOLAR PLANE IN CHILDREN AT FIRST EXAMINATION

AGE	NUMBER OF CHILDREN	AVERAGE ANGLE (DEGREES)
Under 3 years, 6 months	21	93.67
3 years, 6 months to 3 years, 11 months	33	95.18
4 years and over	13	95.85

AVERAGE INCREASE IN ANGLE OF LABIAL SURFACE OF MAXILLARY CENTRAL INCISOR TO THE INCISOR MOLAR PLANE IN CHILDREN				
	INTERVAL BETWEEN EXAMINATIONS			
	23 MONTHS AND UNDER		24 MONTHS AND OVER	
	NUMBER OF CHILDREN	AVERAGE INCREASE (DEGREES)	NUMBER OF CHILDREN	AVERAGE INCREASE (DEGREES)
Under 3 years, 6 months	7	3.14	14	5.00
3 years, 6 months to 3 years, 11 months	13	4.77	20	4.80
4 years and over	10	3.50	3	1.00

Note: Four children showed a decrease and three showed no difference.

TABLE III.
CHANGE IN ANGLES OF DIVERGENCY OF ROOTS OF MAXILLARY DECIDUOUS CENTRAL INCISORS IN CHILDREN

GROUP	NUMBER OF CHILDREN	MEAN (DEGREES)	GROUP	INCREASE IN MEANS (DEGREES)	STANDARD ERROR
Original Grouping					
I	45	15.31	I to II	0.73	1.14
II	81	16.04	II to III*	3.49	1.61
III	45	19.53	I to III*	4.22	1.76
Subgroups Showing Little or No Spacing of Crowns					
I	28	16.05	I to II	1.49	1.40
II	57	17.54	II to III*	5.83	1.83
III	31	23.37	I to III*	7.32	2.04
Subgroups Showing Good Spacing of Crowns					
I	17	13.50	I to II	-1.19	2.02
II	23	12.31	II to III	-1.27	1.97
III	14	11.04	I to III	-2.46	2.16

*These increases are significant.
Group I, 3-year-olds.
Group II, 4-year-olds.
Group III, 5-year-olds.

direction of eruption of the permanent incisors so that the crown is tilted labially, and the length of arch at midalveolar point is increased after the eruption of the permanent incisors.
Everything points to the fact that root spacing of deciduous incisors takes place, the alveolar spacing, and labial tilting of

root, although the increase of the angle of divergency between Groups I and II is not statistically significant.
The question arose whether root spacing, which appears to be important in the chimpanzee, occurs with any frequency in human beings.
The tilting labially of the roots of the



FIGURE 21

Radiographs showing the two types of spacing of deciduous incisors in human beings. Root and crown or divergency of roots.

maxillary deciduous incisors that Miss Clinch had obtained from her serial models seemed to suggest it. Sixty-four cases had increases, three showed no difference, and four showed a decrease.

I then obtained radiographs of the crowns and roots of the maxillary deciduous central incisors of 369 children. One hundred thirty-eight of these radiographs were not suitable for measuring the angle of divergency of the roots, owing to either the radiograph being taken at a wrong angle or obvious malocclusion. Fourteen and three-tenths per cent had unilateral or bilateral rotation of permanent central incisors. The permanent laterals, usually rotated, were lying labial to the centrals.

The angles of divergency were measured on:

Forty-five cases, 3 years.

Eighty-one cases, 4 years.

Forty-five cases, 5 years.

Sixty-one cases, 6 to 7 years.

The sixty-one cases, 6 to 7 years, had

too little root left to be measured accurately.

A not significant difference was obtained between the angle of divergency between the 3- and 4-year-olds, but a significant increase between 4- and 5-year-olds.

I then divided the cases that had little or no spacing of the crowns and the cases that had good spacing of the crowns.

There was a marked increase in the angle of divergency in the no-spacing cases, but a decrease in divergency in the spaced cases (Fig. 21 and Table III).

Apparently, growth of alveolar bone in human beings can show itself in the following ways: by root and crown spacing, by root spacing, or by a combination of both. In the chimpanzee skulls it shows only by root spacing.

The second part of this investigation of the chimpanzee skulls was to see if any changes occurred in the occlusion of the cheek teeth. Horizontal measurements were taken between the distal surfaces of the maxillary and mandibular second

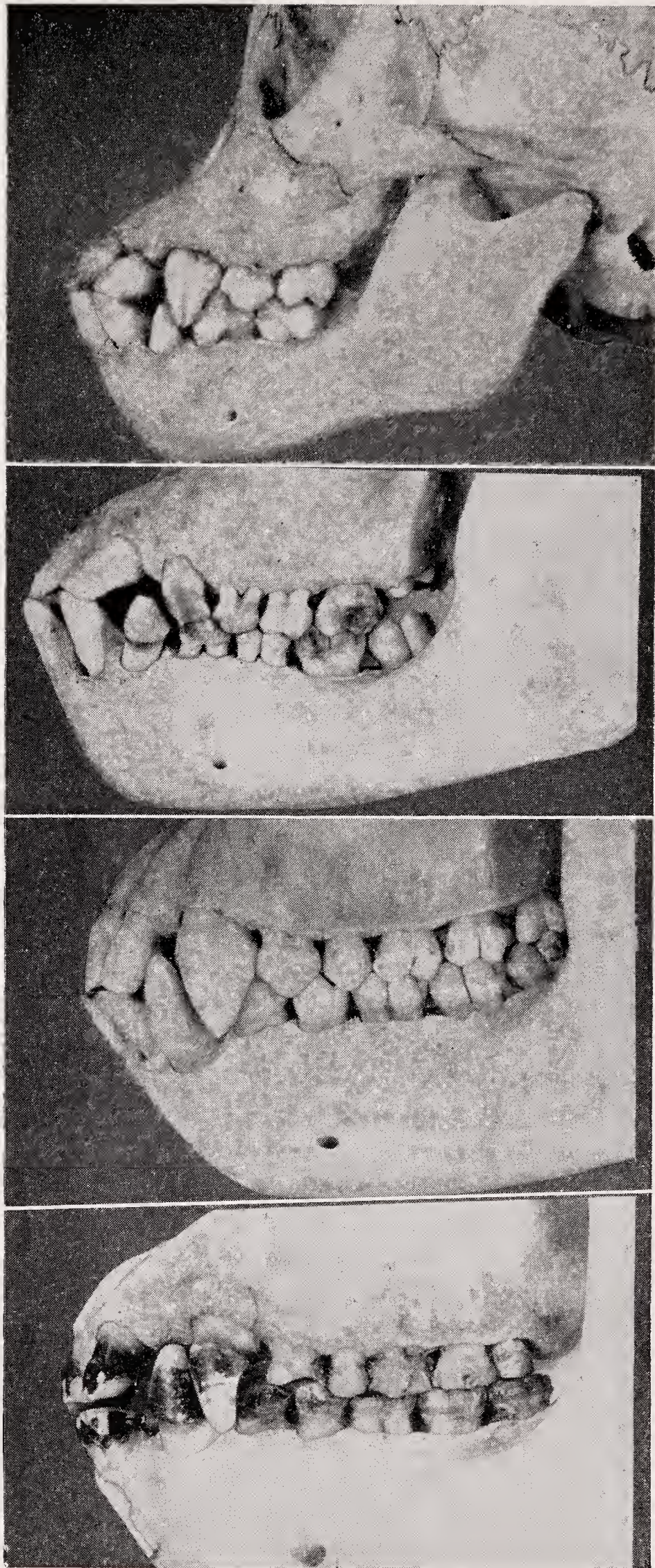


FIGURE 22

Side views of skulls in Fig. 20, showing gradually forward positioning of mandibular teeth in relation to maxillary teeth. (Powell-Cotton Museum.)

TABLE IV

GROUP	NUMBER IN GROUP	MEAN (MILLIMETERS)	GROUP	INCREASE IN MEANS (MILLIMETERS)	STANDARD ERROR
<i>Figure HR</i>					
I	18	0.92	I to II	0.28	0.20
II	41	1.20	II to III	-0.06	0.17
III	22	1.14	III to IV*	0.54	0.24
IV	31	1.68	IV to V	0.04	0.28
V	28	1.72	V to VI	0.28	0.22
VI	26	2.00	VI to VII	0.43	0.30
VII	19	2.43			
<i>Figure HL</i>					
I	21	0.95	I to II	0.25	0.17
II	41	1.20	II to III	-0.01	0.20
III	21	1.19	III to IV	0.32	0.26
IV	32	1.51	IV to V	0.09	0.24
V	29	1.60	V to VI	0.37	0.20
VI	26	1.97	VI to VII	0.33	0.26
VII	19	2.30			
<i>Figure QR</i>					
I	22	2.36	I to II*	0.78	0.17
II	48	3.14	II to III	0.18	0.14
III	27	3.32	III to IV*	0.35	0.14
IV	34	3.67	IV to V	-0.10	0.20
V	28	3.57	V to VI	-0.04	0.24
VI	28	3.53	VI to VII	0.32	0.26
VII	22	3.85			
<i>Figure QL</i>					
I	24	1.80	I to II*	0.94	0.14
II	47	2.74	II to III*	0.37	0.14
III	27	3.11	III to IV*	0.33	0.14
IV	34	3.44	IV to V	0.27	0.20
V	27	3.71	V to VI	-0.13	0.22
VI	28	3.58	VI to VII	-0.07	0.20
VII	20	3.51			
<i>Figure RR</i>					
I	14	26.79	I to II	0.30	0.37
II	42	27.09	II to III*	1.45	0.61
III	20	28.54	III to IV*	4.52	0.65
IV	27	33.06	IV to V	0.66	0.63
V	26	33.72	V to VI	-0.37	0.74
VI	21	33.35	VI to VII	-0.19	0.79
VII	18	33.16			
<i>Figure RL</i>					
I	16	26.53	I to II	0.24	0.41
II	39	26.77	II to III*	1.69	0.62
III	20	28.46	III to IV*	4.93	0.72
IV	28	33.39	IV to V	0.66	0.72
V	24	34.05	V to VI	-0.19	0.75
VI	22	33.86	VI to VII	-0.58	0.76
VII	17	33.28			
<i>Figure SR</i>					
I	12	12.22	I to II	0.43	0.28
II	40	12.65	II to III*	1.36	0.66
III	19	14.01	III to IV*	5.42	0.69
IV	27	19.43	IV to V	0.70	0.55
V	25	20.13	V to VI	-0.20	0.80
VI	21	19.93	VI to VII	-0.42	0.82
VII	17	19.51			

*These increases are significant.

TABLE IV—CONT'D

GROUP	NUMBER IN GROUP	MEAN (MILLIMETERS)	GROUP	INCREASE IN MEANS (MILLIMETERS)	STANDARD ERROR
<i>Figure SL</i>					
I	14	11.83	I to II*	0.58	0.28
II	38	12.41	II to III*	1.31	0.65
III	19	13.72	III to IV*	5.63	0.69
IV	27	19.35	IV to V	0.70	0.54
V	24	20.05	V to VI	0.13	0.69
VI	22	20.18	VI to VII	-0.53	0.86
VII	15	19.65			

*These increases are significant.

deciduous molars or second premolars, QR and QL; the horizontal distance between the distal surface of the maxillary second deciduous molar or second premolar and the medial surface of the mandibular canine, RR and RL; and the horizontal distance between the distal surface of the maxillary canine and the medial surface of the mandibular canine, SR and SL. Also measurements were taken of the space medial to the maxillary canine and distal to the mandibular canine (HR and HL). (Fig. 22 and Table IV).

In the chimpanzee the distal surfaces of the maxillary and mandibular second deciduous molars do not end off-flush, as in human beings, but the mandibular distal surface is more medial than the maxillary distal surface. This distance *increases significantly*, Groups I to II, II to III, and III to IV on the left side, and I to II and III to IV on the right side, but the increase II to III on the right side was *not significant*, although in the right direction (Q).

The distance between the distal surface of maxillary second deciduous molar or premolar and the medial surface of mandibular canine *increases significantly*, Groups II to III and III to IV (R).

The distance between the distal surface of maxillary canine and the medial surface of mandibular canine *increased significantly*

Groups I to II, II to III, and II to IV on the left side, and II to II, and III to IV on the right side (S).

The space distal to the mandibular deciduous canine decreased between Groups II to III very slightly and *not significantly*. All other groups increased, but *not significantly* (H).

It would appear, therefore, that there is a relatively greater forward movement of the mandibular cheek teeth than of the maxillary teeth, and this is in accordance with similar measurements carried out by Miss Clinch¹¹ on her serial models of children. Baume¹⁰ also found a forward movement of the teeth distal to the mandibular canines in children, but considered it as at the expense of closure of the space distal to the mandibular canine. My measurements on the chimpanzee skulls showed a very slight closure of this space, but not at all sufficient to account for the forward positioning of the mandibular teeth in relation to the maxillary teeth.

Baume¹⁵ carried out a series of measurements on the Macaca monkey. He found that there was a sufficient overhang (or terminal step) of the maxillary second deciduous molar to allow the first permanent molars to occlude correctly. The teeth of the Macaca monkey are very different from chimpanzee or human teeth;

there is a much more definite interdigitation of the cusps of the cheek teeth.

Evidence of bone growth both by Brash¹⁶ and Scott¹⁷ would appear to support the greater forward movement of the lower teeth. One has to remember that ideal occlusion of the teeth is the final product of normal bone growth and of normal function.

CONCLUSION

I have attempted in Part I to give a description of ideal occlusion in its many stages, and in Part II to show some evidence in support of root spacing of the deciduous incisors and also some evidence to show the change of relationship of the mandibular arch to the maxillary arch between 3 years and 8 years of age.

ACKNOWLEDGEMENT

This paper is reproduced from the American Journal of Orthodontics, Vol. 40, No. 3, Pages 196-227, March, 1954, by kind permission of the Editor, Dr. Pollock, and the publishers, Messrs. C. V. Mosby Co., St. Louis 3, U.S.A. They also very kindly presented the blocks for the illustrations to the Society.

I should like to thank Mrs. Powell-Cotton of the Powell-Cotton Museum, Birchington, Kent; the Universities of Liverpool, Birmingham, Oxford, St. Andrew's, Edinburgh, Dublin, and Queen's University, Belfast, the Royal College of Surgeons, London; the Natural History Museum, South Kensington, and the Municipal Museums of Liverpool and Edinburgh, for their kindness and for the facilities they gave me when I was examining and measuring the chimpanzee skulls in their museums.

I should like to thank also the many people who obtained radiographs of children for me, especially Dr. Olav Engh of Oslo and Dr. Gilbert Parfitt. I have to thank Miss L. M. Clinch for the measurements of her serial models and for her advice on the early stages of occlusion, and I wish also most sincerely to thank Dr. Bransby for the statistical work and for the great help he gave me in interpreting the figures.

The drawings of the individual teeth in Figs. 5, 6, 13, and 19 are the work of Miss Ethel Quigley. The diagrams in Figs. 2, 7, 11, 12, and 14 were done by Miss Phyllis Wilson, and the diagram in Fig. 9 by Miss Sheila Symes. I am very grateful for the work they did for me.

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DISCUSSION

Mr. W. RUSSELL LOGAN, in opening the discussion, said that one of the troubles of orthodontics had been that its practitioners had had to run before they could walk. They had had to establish their practice long before it had been possible to establish the first principles on which their practice should have been founded. No one had done more than Professor Friel to go back and discover the principles on which the study of orthodontics must be based.

The lecture was a milestone in the progress of orthodontists towards a full knowledge of the development of the dentition.

Any orthodontist who had tried to carry out an examination of skulls knew what a heart-breaking task it was. One discovered a collection of skulls and was shown a room stacked with skulls from floor to ceiling, and then one found that none of them had more than six teeth and those did not meet. Professor Friel's task had been a colossal one and was indeed, as the President had said, his life's work.

Professor Friel had said that occlusion was not a fixed thing and that it varied with the age of the individual. It also varied with the age of the race. Professor Friel had pointed out that old skulls showed an edge to edge bite and that the younger of the skulls showed an overbite. He himself doubted very much whether the skulls of, say, three thousand years ago showed anything like the amount of close bite that was seen to-day. He thought this was a change in dentition which was

occurring with the ageing of the race, and there were, of course, races in the world to-day, notably in China, where distal occlusion and close bite were more common than what was regarded in this country as normal occlusion.

Professor Friel had pointed out the various methods by which the investigation in question could be done. First, there was the series research, in which children were examined at periods throughout their life. It could not be too often reiterated that that was the only type of examination which would give the whole truth in the matter. The second method was to examine children of various ages. That was a very bad second-best and it was the type of work that gave rise to the myths which were so troublesome. It must be remembered that all humans were not morphologically identical and it was even doubtful whether there was one single origin of the human race. He thought that many of the troubles in orthodontics were due to the fact that orthodontists examined such a mixed sample that any conclusions which they drew in regard to the normal were doomed from the outset to be false. The third method was the examination of animals, and that must be taken with an even larger grain of salt, because the connection of human beings with the lower animals, as they were called, seemed to be becoming more tenuous as the knowledge of anthropology increased.

With regard to the substance of the lecture, most of it was factual and there was nothing that one could say about it,

but he must say that he felt very doubtful about Baume's spaces. In his experience he had not seen them. He had seen spaces in the deciduous dentition, but usually they did not occur where the anthropoid spaces occurred, or, if they did so occur, there were spaces in other places at the same time. He thought that orthodontists should be very careful in accepting Baume's spaces and that they should avoid calling them Anthropoid Spaces.

On the question of molar occlusion, he thought that the method which orthodontists had learned from Angle of classifying occlusion by an examination of the buccal cusps of the first molars had held them up a good deal. He did not think that an examination of the buccal surfaces of the first molars gave a good indication of the occlusion. In his opinion, the critical point about occlusion was whether the mesio-lingual cusp of the upper first permanent molar did or did not engage in the central pan of the lower. The mesio-lingual cusp of the upper was a large peg-shaped part which was almost over the centre of gravity of the tooth, and if that engaged in the central pan of the lower there was neutral occlusion. That gave a considerable variation fore and aft and therefore allowed orthodontists to vary their conception of normal occlusion more than the (to his mind) much too accurate relationship of the buccal cusps to the lower groove.

With regard to the distal surfaces of the deciduous molars, he felt that it was taking too narrow a view to say that in the human they were always vertically one above the other. In his experience the distal surfaces of the second deciduous molars might be flush or might not be flush, and the distal surface of the lower molar could be a little mesial or a little distal, by a millimetre, and still end up with what was called a neutral occlusion. He did not think that it should be regarded as abnormal if the distal surfaces of the deciduous molars were not one above the other.

The question of the deciduous canines was, he thought, an extremely important matter, and his experience was that if the deciduous canines were not worn it was unlikely that the child would have what was called normal occlusion. The wear of deciduous canines was, he thought, caused by efficient function and efficient diet. In the old days it was taught that good function produced good arches, but now he did not believe that that was necessarily so. He certainly did not believe that one could increase the size of the jaw bones by chewing hard food, but he thought that if children chewed hard food and chewed it efficiently they would grind down the cusps of the deciduous teeth and allow forward movement of the lower arch to take place.

Dr. LINDSAY said that she was very interested in the subject of the lecture and had been so since 1925, when Dr. Friel was discussing the matter and writing his first paper on it. She could not help thinking also of the following lines of Browning: "The common problem, yours, mine, every one's,

"Is not to fancy what were fair in life

"Provided it could be,—but, finding first

"What may be, then find how to make it fair

"Up to our means."

She thought that Dr. Friel had answered that by saying: "How can you make it fair if you have not an ideal fair against which to work and with which to compare your results?" She was impressed by the immensity of Dr. Friel's work, the enormous amount of thought that he had given to it and the way in which he had compared one condition with another until he had worked out the whole. It was a marvellous piece of work and he had put years of thought into it.

Dr. Friel had omitted any consideration of the premaxilla and the growth there. Looking at the chimpanzee skulls which Dr. Friel had shown, it was evident that there was definitely a growth in the front of the mouth which could explain the

spreading of the roots. Sir Frank Colyer had pointed out in children's skulls that where there was spacing of the deciduous teeth there were open premaxilla sutures—they had not closed—but that when the teeth were close together and crowded growth had not taken place; the sutures had closed and there was no possibility of further growth. She would like to suggest that that was a subject for research. Some people said that these bones did not exist in the human being, but that was obviously wrong, because long ago Mr. Bryant reported that in a case of a child of 4 years of age after severe attack of measles the four maxillary bones were exfoliated, so these bones did exist in human beings and she was quite sure that they were responsible for this growth at the time of the change of dentition. The premaxilla existed on the palate, and in the young chimpanzee it existed in the face before the maxillary suture had closed down over it. In a skull where the premaxilla was absent the teeth on both sides were extraordinarily rotated; the canine had brought its palatal surface right to the front and all the premolars and molars were rotated. She thought it would be a very valuable piece of research to try to discover whether this bone was there or not.

She would like to thank Dr. Friel for his lecture and especially for allowing her to have a copy of it beforehand.

Mr. HAROLD CHAPMAN said that he also would like to thank Professor Friel for allowing him to see his lecture beforehand.

The lecture had involved Professor Friel in a very great deal of work during the past year, and only those who had undertaken such an investigation could really appreciate what he had done: to have visited so many museums all over the country was in itself a remarkable work. Some years ago he had spent many days with Professor Friel in the Bolk Museum in Amsterdam, investigating in particular the problem of the developmental position of the upper lateral incisors.

Dr. Northcroft had been an idealist; the subject of Professor Friel's lecture would have appealed to him. It should be remembered that in the Society's museum there was a wonderful series of facial masks and models of Dr. Northcroft's own children. One of those models had been taken when the child was only 44 days old and perhaps it was the earliest taken at that time, which was about forty years ago. That recalled the fact that Dr. Northcroft was also an eminently practical man. The comments which he was about to make, therefore, were not criticisms but were rather suggestions for amplification and further clarification of Professor Friel's lecture.

With his earlier paper on the subject, Professor Friel's lectures would prove to be a standard work, on which he would like to congratulate him. He was glad to hear that the Professor's earlier paper needed very little alteration, because he kept a copy of it with his lecture notes, for reference purposes, and he liked to keep it up to date.

Last week-end he read Professor Friel's lecture; the next day he came across the following words in an article in a magazine: "Nature insists that every being shall vary in some degree about that happy but unattainable mean that we call ordinary." He had a mental picture of normal or ideal occlusion when the deciduous dentition was just completed and another picture of normal or ideal occlusion when the permanent dentition was completed, but in any two individuals—for instance, one brachycephalic and the other dolichocephalic—there were differences readily discernible in each dentition, which might be ideal for the individual but, like a railway ticket, was not transferable.

In the transition from the earliest deciduous dentition to the young adult permanent dentition there are an infinite number of routes and these routes would lead to the same destination, normal or ideal occlusion. But what about the various

routes themselves? What adjective was there to describe them, if it was not "ideal" or "normal"? If those who said that the ideal was a myth were thinking in terms of one pattern and one only, they might be right, but, if a broader view was taken and, whatever the route, ideal occlusion for the individual was the result, then it was not a myth. Professor Friel had shown clearly that he recognised more than one route when speaking of the upper laterals and again in his discussion of the way in which room was made for the larger upper permanent incisors. It was these various routes which were of such interest to orthodontists. If they did not know them and recognise them, how were they to make a diagnosis, which was the basis of their practical work?

In order to assist him in discussing some of the points in the lecture, he would like to show a few slides.

The first slide showed models of an occlusion which was normal except with regard to the two upper laterals, one of which was labial and the other lingual. He would like to ask whether Professor Friel had any special reasons for believing that if upper laterals were so labial they were not likely to come into normal position. Professor Friel's percentages with regard to labial and lingual laterals seemed to correspond approximately to the number of Class II Division 1 cases and Division 2 cases, of which orthodontists saw so many less of the latter than of the former.

The next slide showed models taken at about 3 years of age, in which there was no approximal contact between the molars. He believed that that was the normal arrangement. He thought that Mr. Maxwell Stephens had been the first to use the expression that "the deciduous arches consist of teeth and spaces," and he believed that in all normal cases there were such spaces between all the teeth on eruption.

The following slide showed models of

a boy at 4 years of age whose tight lower canine was not in the so called typical position and the molars ended flush. On the left was the same boy at 9 years of age, and it would be noticed that there had been a very considerable forward movement of the lower teeth relative to the upper, allowing the lower permanent molar to come more nearly into its final occlusal relation with the upper than could otherwise have been possible. The lower deciduous canine showed very considerable attrition and was well forward in relation to the upper canine.

He now came to the difficult problem of how the lower arch came forward, and it seemed to him that there might be a further explanation. The slide showed two models taken at an interval of three years, the first being taken when the child was 3 years old and the second when she was 6 years old. The lower had come forward, but, in addition, there was a considerable reduction in the overbite, and that probably meant that the molar series had to come down in the upper or up in the lower or there had to be some other change in the incisor region. That case showed another way in which the lower was able to come forward, namely, by the opening of the bite, and that would be a further explanation of why the angle of the labial surfaces of the upper incisors to the occlusal plane increased. There might be another reason also why the lower required less room than the upper. It had been seen that the upper incisors in the permanent dentition were very much further forward than they were in the deciduous dentition, but it might be that the lower incisors were not further forward in the permanent dentition than their deciduous predecessors; in fact, they might even be slightly more lingual, and that would perhaps help to account for the smaller space required for the lower permanent incisors.

The following slide showed models which were in the Royal College of Surgeons museum. The models were taken

when the child was 8 years and 8 months. There was a space between the upper central incisors, although the laterals had erupted, so that the closure was not entirely dependent on the eruption of the laterals. He would also draw attention to the degree of overbite and the inclination of the upper incisors and laterals, because the next slide showed an improvement in both respects.

The four incisors were in better alignment. There was a slight closure of the space and a considerable reduction in the overbite. He wished that Professor Friel had shown some examples of this improved position of the upper laterals, because he knew that the Professor had some very good examples of that.

The next case was of a girl whose models he showed at about 6 years of age and nine months later. In that short time the space had closed from 6 mm. to under 3 mm.; there had been no change in the dentition; the upper laterals were unerupted.

The cases already shown were examples of normal. The case shown in this slide was probably not normal, but it showed another variation, in that the first upper permanent molars, at 8 years of age, were caught at the necks of the deciduous upper molars, whereas a year or eighteen months later they had freed themselves. That showed that it was not necessary to take any action about it. It was one of the various routes to normal occlusion, and, even if the molars did not right themselves, it was his experience that it was not necessary to do anything about it, because it did not affect the position of the premolars or the canines later on. The case developed into a normal one as far as this particular variation was concerned.

He would like to ask whether Professor Friel thought that the distal surfaces of the upper laterals in the deciduous and the permanent dentitions were more or less coincident? He, the speaker, thought this the only point that was comparable in the two dentitions.

He also enquired whether Professor Friel had any idea of the total amount of wear of the teeth from eruption to old age.

The lecture was one to which students would refer very frequently. They would regard it as the basis of their orthodontic education, and therefore the lecture must not be looked upon as dealing with a myth. All that Professor Friel had said was of the greatest importance, and the amount of investigation that he had done in many parts of Great Britain and Ireland was worthy of the highest commendation.

Miss K. C. SMYTH said that she felt it a great privilege to have been rooted and grounded in the conception of the development of the teeth which Professor Friel had put before the members in this lecture. She realised that it had made a solid foundation on which other orthodontists had been able to build. There were variations and changes of opinion on etiology and treatment and in various ideas in connection with orthodontics, but everything must be based on a proper concept of the normal or ideal (whichever one liked to call it), and for that concept she would like to thank Professor Friel.

She happened to have with her some illustrations of a case which she thought would fit into Professor Friel's scheme, and if she handed them to him perhaps they would take the place of one of Professor Friel's cases which had been accidentally consigned to the flames.

Mr. R. E. RIX said that it had been a double pleasure to listen to Professor Friel on the present occasion, because not only had he given the Northcroft Lecture but he had dealt with a subject which had been his lifelong interest. He was sure that the lecture would form a most valuable basis for every student of orthodontics for many years to come.

He would like to know whether Professor Friel had anything to say about axial inclination of permanent incisors in

the adult. From the work of Björk it appeared that the proclination of upper and lower incisors decreased between the middle teens and the 20's. Could Professor Friel confirm that observation from the material that he had used ?

With regard to the slow development of the edge to edge bite, he wondered whether the edge to edge bite really entailed a closing of the bite, as Professor Friel had suggested with an evitable forward swing of the mandible. He felt that people continued to increase the vertical height of the lower half of their faces until they became fairly old and their mandibles grew forwards. In fact, with age they became slightly acromegalic. He would like to know what Professor Friel thought about that point.

As to the first age group and the difficulty in establishing a relationship between the gum pads, Sillman had put some wax between the gum pads and just pressed the lower jaw up. That sounded unscientific, but, in his own small experience of trying to obtain a relationship in the vertical plane, he had found that just a little pressure was required until resistance to further closure was sensed. If one pressed the top of the head down and the lower jaw up as hard as one could, one would get a contact relationship, but with gentle upward pressure on the lower jaw one would get something that was fairly standardised, and he did not think that this palpably loose procedure was very unscientific.

Mr. D. F. GLASS, referring to the question of the edge to edge bite, said that about the age of 6 years it varied with each individual. From reading books and articles in which the subject was discussed, he was not convinced that the edge to edge bite was due to wear of the cusps, and he thought that possibly Mr. Chapman's view of it was more on the right lines, but he still did not think it was correct. He wondered whether Professor Friel would

agree that at about the age of 5 to 6 years there was a skeletal upspringing after a filling-out period from the age of 1 year to the age of about 5 years. He was not sure about those figures, but his point was that during the period of about 5 to 6 years of age there was a good deal of cartilaginous deposition in the epiphysial plates of the long bone, and during the filling-out period there was appositional deposition of bone from the periosteum. If that was applied to the maxilla and the mandible, two entirely different bones, the maxilla would grow by a deposition of the periosteum during the filling-out period and the mandible would grow by cartilaginous deposition at the head of the condyle during a jumping-up period of the skeletal tissues. During the period of about 5 to 6 years of age, the lower jaw came forward to an edge to edge occlusion, due to the growth of the head of the condyle, and the maxilla was relatively slower at that period. Would Professor Friel consider that that was a major factor or not ?

Mr. H. T. A. McKEAG said that he had been arguing on orthodontics with Professor Friel for many years, but one subject on which he had never dared to argue with him was the development of the occlusion. All he could do in that connection was to follow behind Professor Friel and pick up bits of information.

He would suggest that it was useful to think of a process by which an occlusion of some sort was reached, whether ideal or not, and Professor Friel had set forth in his lecture the process or processes by which an ideal conclusion was most likely to be reached. It was essentially a process, but as Mr. Chapman had pointed out it was not just one process. The essential features were similar in all human beings, but not necessarily the same and, from a knowledge of the variations and some shots at prediction, orthodontists judged whether the process as they saw it in the individual was likely to lead to normal occlusion or not. One of the features of the process

(Mr. Chapman had called them routes) which had not been mentioned on the present occasion but which clearly at times led to normal occlusion was that the permanent incisors were not necessarily accommodated in the line of the curve between the deciduous canines. One of the routes to normal incisor position and to normal occlusion was an overlapping of the lateral incisors over the deciduous canines. That could make a break in the curve for the time being, but in the eruption of the permanent canines in a more labial position than the deciduous canines it would eventually produce the regular curve which was associated with normal occlusion.

He would like to express his thanks to Professor Friel for his lecture.

The PRESIDENT, referring to the point mentioned by Mr. Rix about occluding gum pads, said she agreed that if one put a great deal of pressure on an infant's mandible one could do almost anything with it, because there was no articular eminence and the glenoid fossa was practically flat. One could get the mandible completely out of position by the use of force. She knew, however, from her personal experience and that of other people, that it was possible to get the upper and lower gum pads into a bite and they could be got time and time again into the same position. She realised that there was a large space between the gum pads at rest, but she still felt that there was an occlusion of the gum pads as well.

Mr. Glass had referred to the maxilla growing more slowly than the mandible between the ages of about 5 and 6 years. When she had been measuring the angle of the occlusal plane to the labial surface of the deciduous incisors, one of the things which she had found most interesting was the enormous increase in the vertical height of the premaxilla between the early models and the late models. She thought the reason why she had found that was that

she could not get the instrument which she used properly to the surface in the early models without cutting away the whole base of the model, whereas in the 5-year and 6-year models it was quite simple to do that. She did not know about the increase in the mandible, but there certainly was a very large vertical increase in the premaxilla at that age.

Professor S. FRIEL, in replying to the discussion, said that his lecture was a description of ideal occlusion and not normal occlusion. They were two very different things. He had avoided discussing the growth of bone which was the cause of occlusion or the changes in occlusion. He had given the final product and had not discussed how that final product was brought about. It was brought about by bone, and he had stated that the growth of bone caused it.

It was customary not to have a discussion on the Northcroft Lecture, and he thought that it was a great mistake, from his point of view, that the custom had been set aside on the present occasion, but he would like to thank the speakers for the kind remarks which they had made about his lecture.

Mr. Russell Logan had referred to the number of close bites found in ancient skulls. There had been very few young prehistoric skulls found in Great Britain. He had seen one Bronze Age skull. He had seen several skulls of fairly young people where the overlapping of the incisors was one-half to one-third of the lower incisors, but the vast majority of the skulls which had been found were those of people who had used their teeth, adults whose teeth were worn down and had edge to edge bites, and the occlusion of the molars was similar to the occlusion of the molars in people like Eskimos, whose lower molars were further medial to the upper molars than they would be in a young adult. He thought it must be wear that produced this edge to edge bite—he did not think it could be anything else—

and in the chimpanzees the wear and then the movement forward were very pronounced. The difference was significantly increased in his measurements, and when the teeth became very worn the whole lower jaw had come a great deal further forward.

Mr. Russell Logan had said that he thought the medio-lingual cusp of the upper first permanent molar was a better indication of whether a case was normal or not. Where there was a rotated upper molar, as there was in the majority of non-forward movement cases, the medio-lingual cusp was in the centre of the fossa, but the other cusps were not in correct occlusion. He thought it was necessary to take at least two points. He did not think that the medio-buccal cusp was enough; it was probably better to take the triangular ridge of the medio-buccal cusp and the "oblique" ridge, and then one had two points from which to judge. The taking of one point only did not get rid of rotations.

Flush occlusion, to which Mr. Russell Logan had referred, should occur only in the early stages of the complete deciduous dentition, from $2\frac{1}{2}$ to $3\frac{1}{2}$ years of age, and it should then disappear.

Dr. Lindsay had made some very kind remarks and she had written him one of the most charming letters that he had ever received. He did not know how to answer her point about the premaxilla, and he would say that he was describing only teeth and not the premaxilla. He thought there must be some reason why there was divergency of roots in some children and space in other children, but he did not know what the reason was. Whether there was growth in the premaxilla he did not know, and it would need an anatomist to do the sort of investigation which Dr. Lindsay suggested. He himself was only a clinical orthodontist.

He did not know the total amount of wear in the old-age skulls. He believed that Stein and Weinman had given some measurements in a paper. In order to

investigate this question it would be necessary to tour the world to get sufficient skulls to measure.

He thought that a great number of the cases which Mr. Chapman had shown would be regarded as cases of normal occlusion eventually, but they were not cases of ideal occlusion. He could indicate various points that were not ideal. Mr. Chapman and he had often argued this question. He held that there was only one ideal occlusion but that there were millions of normals, and Mr. Chapman took a different view.

He understood that Mr. Rix wanted to know whether there was less proclination of the incisors between the ages of 10 and 20. He had not any measurements of human beings, but in chimpanzees the angle did decrease. The angle increased in the first two groups, i.e., the deciduous teeth only and the deciduous teeth plus the first permanent molars, but when the permanent incisors erupted it decreased; they inclined out much more. Then later it increased again.

The President had replied to Mr. Glass.

With regard to Mr. McKeag's remarks, the overlapping of the lateral incisors over the canines might be normal but it was not ideal. The ideal was a very definite thing, and the normal was quite different. For example, the spacing between the upper lateral incisor and the canine should occur in an ideal occlusion; if it did not occur, there was a very slight crowding and overlapping of the lower incisors. He had never seen a case of ideal occlusion without a space between the lateral incisors and the canines and the lower incisors absolutely regular. There was normal occlusion if the lower incisors were twisted a little and there was no space between the upper lateral and canine, but it was not ideal occlusion.

The PRESIDENT said that Professor Friel's lecture was indeed a *tour de force*. It

seemed to her that it was an essential part of the foundation of orthodontics, for how could orthodontists build up a conception of what was normal or abnormal except on a sound basis of the ideal ?

The Society was very fortunate not only because the lecture had been read before it but also because the lecture, with its unique illustrations, would be published in the Transactions of the Society. She had some idea of the amount of work that had been put into its preparation, and she could assure the members, if they needed

any assurance, that it was phenomenal.

It must be a source of satisfaction to Professor Friel that he had had to change so little of what he had stated twenty-six years ago. Not many orthodontists, she thought, were so accurate in their observations. Professor Friel had produced a worthy result of what she was sure he would agree had been his life's work.

On the motion of the President, a vote of thanks was accorded to Professor Friel for his lecture, and the meeting then terminated.

Ordinary Meeting

held on January 12th

AN ORDINARY MEETING of the Society was held at Manson House, 26, Portland Place, London, W.1., on Monday, January 12th, 1953, at 7.30 p.m. Mr. J. F. Pilbeam, President, occupied the Chair.

The HON. SECRETARY (Mr. Howell Richards) read the notice calling the meeting and the Minutes of the Annual General Meeting held on December 8th, 1952, which were confirmed and signed.

The PRESIDENT said that members of the Society would be very grieved to hear of the death of Mr. Maxwell Stephens. Mr. Stephens had been elected a Fellow in Dental Surgery of the Royal College of Surgeons of England in 1948. He had been admitted to membership of the Society in 1911 and had been Curator from 1912 to 1925, Vice-President from 1924 to 1927 and President in 1928, an office which he held with distinction and dignity. He had been an ardent supporter of the Society and a constant attender at its meetings, and he had made many valuable and interesting contributions to the field of orthodontics. In 1929 he had presented to the Society the President's badge of office. He had been President of the Odontological Section of the Royal Society of Medicine in 1942-43 and President of the European Orthodontic Society in 1948.

Mr. Maxwell Stephens had had a genial and charming personality and he would be missed by a large number of friends. The Council of the Society had instructed the Honorary Secretary to send a letter of sympathy to Mr. Stephens' family. A memorial service would be held in St. Peter's Church, Vere Street, on Friday, January 23rd, at 12.30 p.m.

The members and visitors present stood in silence for a few moments.

The following candidates for membership of the Society, who had been approved by the Council, were elected *en bloc* by show of hands:—

Mr. F. H. Butler, B.D.S. (Lond.), 35, Chauncy House, Sish Lane, Stevenage;

Mr. E. O. Clough, L.D.S., R.C.S. (Eng.), 54, Hadleigh Road, Leigh-on-Sea;

Miss J. M. Dodd, L.D.S., R.C.S. (Eng.), 7, Thornfield Road, Bishop's Stortford.

Mr. W. H. Edmonds, L.D.S. (U. Birm.), Buckingham House, Graham Road, Malvern, Worcs.;

Mr. W. D. P. Evans, L.D.S., R.C.S. (Eng.), Tynlon, Rhydyfelin, Aberystwyth;

Mr. P. D. Harvey, M.R.C.S., L.R.C.P., L.D.S. (Eng.), 78, Banbury Road, Oxford;

Mr. P. J. Holloway, B.D.S., L.D.S., R.C.S. (Eng.), 31, Barry Road, East Dulwich, S.E.22;

Miss L. M. Meadowcroft, B.D.S., L.D.S., R.C.S. (Eng.), 228, South Norwood Hill, S.E. 25;

Miss H. M. Rogers, B.D.S. (Lond.), Red Cottage, Laleham-on-Thames, Middlesex;

Mr. R. C. P. Salter, L.D.S., R.C.S. (Eng.), 53, Hillside Crescent, Leigh-on-Sea;

Mr. J. M. Scoones, L.D.S., R.C.S. (Eng.), 10, Wilton Crescent, S.W.19;

Mr. A. J. N. Swann, B.D.S. (Durham), 10, Lansdown Place, Bristol, 8;

Mr. N. J. Wood, L.D.S., R.C.S. (Eng.), 68, Fellows Road, N.W.3.

The PRESIDENT welcomed the visitors who were present and invited them to consider themselves members of the Society for the evening and to take part in the discussion on the Presidential Address and

on the paper which was to be read by Mr. B. C. Leighton, on "Some Abnormalities seen in the Deciduous Dentition." This, he said, was a very important matter and had been the subject of two excellent Presidential Addresses, the first by Dr. George Northcroft in 1929, entitled "Malocclusions of the Deciduous Dentition," and the second by Mr. A. T. S. Pitts, in 1931, entitled "Some Observations on Malocclusion in the Deciduous Dentition." Soon after that a paper had been read to the Society on the subject of malocclusion of the temporary dentition.

The following paper was then read:
"Some Abnormalities Seen in the Deciduous Dentition" by Mr. B. C. Leighton
 The vote of thanks was carried by acclamation.

The PRESIDENT, before reading his Presidential Address, expressed his appreciation of the honour which the members

had conferred upon him by electing him as their President and said that, although he could not emulate his predecessor's erudition, he would do his best to serve the Society in every way.

With regard to the subject of his address, Orthodontic Schemes, the Society spent a good deal of time in dealing with scientific and academic subjects, but it was not often that the administrative side of orthodontic work was considered. The views expressed in his address were his personal views and were not sponsored by the Council of the Society.

The PRESIDENT then read the following Presidential Address:

"Orthodontic Schemes"

The vote of thanks was accorded with applause, and the meeting then terminated.

Ordinary Meeting

held on February 9th

AN ORDINARY MEETING of the Society was held at Manson House, 26, Portland Place, London, W.1., on Monday, February 9th, 1953, at 7.30 p.m. The President, Mr. J. F. Pilbeam, occupied the Chair.

The SECRETARY read the notice convening the meeting.

The Minutes of the Ordinary Meeting held on Monday, January 12th, 1953, were read and were confirmed and signed.

There were no matters arising out of the Minutes.

The PRESIDENT informed members that the Demonstration Meeting would be held

on Monday, May 4th, the first instead of the second Monday in the month.

He also reminded members that the European Orthodontic Congress would be held from May 10th to 14th. The Bank of England would only allow thirty members of the Society to apply for special allotments of foreign currency and anyone who wished to avail himself of this should write to Mr. Norman Gray, 16, College Road, Eastbourne, at once, as there were only eight vacancies left.

He called upon Mr. C. F. Ballard, the Editor of the *Transactions*, to make an announcement.

Mr. BALLARD said this was not an announcement that he wished to make, but he was compelled to do so because members of the Society were enquiring about the *Transactions*.

He had informed the Annual General Meeting that as far as he was concerned, the publishers were producing the 1950 *Transactions* before Christmas. That was what they had told him. The copies were in the hands of the binders, and the printers were apparently over-optimistic about the binders.

The printers had assured him that they were going to make every effort to bring the *Transactions* up to date. In other words, the 1951 and 1952 *Transactions* would be published this year. Unfortunately, they were held up because many of the papers had not yet come to hand. Although he would like to do anything he could to help, it was impossible for him to do more to stimulate the writers of the papers than he had already done. The *Transactions* would be thin if they were published without some of these papers. All he could promise was that it was hoped to be up-to-date by the end of the year. In future, *Transactions* should be ready within a few months of the end of the year.

The PRESIDENT said that he was sure members appreciated the great difficulties of the Editor in getting the *Transactions* completed. As a previous Editor, working in similar difficulties, he extended to Mr. Ballard his very keen sympathy. He felt sure Mr. Ballard was doing his best to get them out in time and to ensure that they were brought up-to-date as quickly as possible.

Six members whose election had been confirmed at previous meetings and who had not been introduced to the President were admitted by him as members of the Society.

The following candidates were elected *en bloc*:

Ordinary Membership

Mr. S. K. Doran, L.D.S., 36, Holders Hill Road, London, N.W.4.

Mr. J. R. Heath, B.D.Sc. (U. Melb.), Eastman Dental Hospital, Gray's Inn Road, W.C.1.

Honorary Membership

Mr. F. Bocquet Bull, 15, Upper Wimpole Street, London, W.1.

In commending the election to honorary membership of Mr. Bocquet Bull, the PRESIDENT said that he had done excellent work for the Society and had contributed to meetings on several occasions. To the old Guy's man he was particularly well known, because in 1919 he was the first dental surgeon of the hospital to be put in charge of a new children's department—an orthodontic department. This was an innovation in those days, and he had laid the foundations for an excellent children's department which had been carried on admirably by Mr. Rix. He was also President of the Society in 1936.

The PRESIDENT then said that the Society was privileged to have with it that evening several distinguished visitors. He would refer first to Professor Neale, Professor in Child Health in Bristol University. Also present was Dr. Tegner, who was Lecturer in Orthodontics at Malmö Dental School, Sweden. He extended to them a hearty welcome and expressed the hope that they would take part in the discussion.

Lastly, he welcomed any other visitors who might be present. He invited them to regard themselves as members for the evening and to take part in the discussion.

The PRESIDENT said that the Society was to be congratulated on having with it Dr. H. R. Wallis, who had kindly consented to speak on "Medical Aspects of Malocclusion." The subject had been somewhat neglected in the past and they looked forward to hearing what he had to say.

Dr. Wallis's qualifications for speaking on this subject were excellent. He was a Consultant Paediatrician to the Bath Area

and Clinical Assistant to the Bristol Children's Hospital. He was a doctor of medicine and a member of the Royal College of Physicians and held the Diploma in Child Health. He felt sure they would all be greatly enlightened upon many aspects of the subject which had hitherto presented difficulty in their minds.

Dr. H. R. WALLIS then gave his address.
"Medical Aspects of Malocclusion"

The vote of thanks was carried by acclamation.

The PRESIDENT thanked the openers of the discussion, Miss Clinch and Professor Neale for contributions which had opened a field for a valuable discussion. (*Applause*)

Ordinary Meeting

held on March 9th

AN ORDINARY MEETING of the Society was held at Manson House, 26, Portland Place, London, W.1., on Monday, March 9th, 1953, at 7.30 p.m. Mr. J. F. Pilbeam, President, occupied the Chair.

The HON. SECRETARY read the notice calling the meeting and the Minutes of the last meeting, held on February 9th, 1953, which were confirmed and signed.

The following newly elected members were introduced to the President and signed the Obligation Book: Mr. S. K. Doran, Mr. P. D. Harvey and Mr. J. R. Heath.

The following candidates for membership of the Society were elected by show of hands:

Mr. G. G. T. Fletcher, L.D.S., 14, Wimpole Street, W.1.;

Mr. C. V. Hill, B.D.S., Orthodontic Section, Eastman Dental Hospital, Gray's Inn Road, W.C.1.

The President welcomed the visitors who were present and asked them to consider themselves members of the Society for the evening and to take part in the discussion on the papers.

The following papers on this subject were read by Mr. C. F. Ballard and Mr. D. P. Walther:

"Some Cases to Illustrate the Relationship Between Aetiology, Prognosis and Treatment Planning"

The vote of thanks was accorded by acclamation and the meeting then terminated.

Demonstration Meeting

held on May 4th

THE DEMONSTRATION MEETING of the Society was held at Manson House, 26, Portland Place, London, W.1., on Monday, May 4th, at 7.30 p.m.

The Minutes of the previous Ordinary Meeting, held on March 9th, were read, confirmed and signed.

The following candidates for election were admitted to membership:

Mr. W. Elgey, L.D.S., R.C.S. (Edin.), 72, Ruskin Avenue, Lincoln; Mr. G. Tegner, Tandläkerexamen (Stockholm), Kullagatan 30; Hälsingborg, Sweden (Corresponding member).

The following Demonstrations were given:

Mr. W. H. Littlefield: *Examples of Specialist and Non-Specialist Orthodontic Treatment.*

Mr. C. V. Hill: *Round Arches and Multi-band Technique.*

Mr. C. K. McNeil: *Application of Orthodontics in the Treatment of Congenital Cleft Palates.*

Mr. J. R. Halden: *The Edgewise Arch.*

Mr. H. Anderson: *X-ray Planigraphy.*

Mr. R. O. Hellier: *Orthodontics on the Older Teenager.*

Mr. S. E. Wallis: *Electric Soldering.*

Capt. P. J. Ceremello: *Some Edgewise Techniques, and Cases treated with the Edgewise Appliance.*

Ordinary Meeting

held on October 12th

AN ORDINARY MEETING of the Society was held at Manson House, 26, Portland Place, London, W.1., on Monday, 12th October, 1953, at 7.30 p.m., Mr. J. F. Pilbeam, President, occupying the Chair.

The HON. SECRETARY read the notice convening the meeting and the Minutes of the Demonstration Meeting held on 4th May, 1953, which were confirmed and signed.

THE PRESIDENT referred with regret to the death of three members of the Society, Miss K. C. Smyth, Mr. J. H. Badcock and Mr. A. E. Rowlett, which had taken place since the last meeting of the Society. He said that they had played their part in life extremely well and their work would long be remembered.

The PRESIDENT announced that it was proposed to form an Orthodontic Group and he read a letter on this subject which had been published in the *British Dental Journal* for 15th September.

The following recently elected members were introduced to the President and signed the Obligation Book: Mr. J. N. K. Clarkson and Mr. W. Elgey.

The following candidates for membership of the Society were duly elected *en bloc* by show of hands:—

Miss J. MacInerney, B.D.S., 85, Brook Green, London, W.6;

Mr. A. W. Greenwood, B.D.S., Royal Hospital, West Street, Sheffield, 1;

Mr. K. Lees, L.D.S., R.C.S. (Eng.), 22, Pashley Road, Eastbourne;

Major Peter J. Ceremello, D.D.S., 3463, Jordan Road, Oakland, California (Corresponding Member).

The PRESIDENT announced that the Minister of Health had accepted the nomination put forward by the Society and had invited Mr. Pringle to be a member of the Dental Advisory Committee. He was very glad that this had been done, as he felt sure that an orthodontist of experience would be a very valuable member of the Committee.

The following short communication was then read:—

“*Methods of Recording Interdental Pressures using the Strain Gauge*,” by Mr. D. J. Anderson, B.D.S.

The vote of thanks was accorded with acclamation.

The following paper was then read:—
“*Methods of Recording Patterns of Behaviour of the Oro-Facial Muscles with the Electromyograph*,” by Mr. W. J. Tulley, B.D.S.

The vote of thanks was accorded with acclamation, and the meeting then terminated.

Ordinary Meeting

held on November 9th

AN ORDINARY MEETING of the Society was held at Manson House, 26, Portland Place, London, W.1, on Monday, November 9th, 1953, at 7.30 p.m. Mr. J. F. Pilbeam, President, occupied the Chair.

The HON. SECRETARY read the notice convening the meeting, and the Minutes of the previous meeting, held on October 12th, 1953, which were confirmed and signed.

The PRESIDENT welcomed the visitors who were present and invited them to consider themselves members of the Society for the evening and to take part in the discussion. He was particularly glad to welcome Professor de Silva, Professor of Physiology at the London Medical School, who he hoped would contribute to the discussion.

The following candidates for membership of the Society were elected *en bloc* by show of hands:—

Miss N. Shotts, L.D.S., R.C.S. (Eng.)⁶
12, Woodville Road, Ealing, W.5;

Miss B. E. E. White, L.D.S., R.C.S.
(Eng.), Twitten Cottage, Ashurst, Nr.
Tunbridge Wells, Kent;

Mr. R. Edmondson, B.D.S., Abbey
Grange, Magdalen Street, Glastonbury,
Somerset;

Mr. J. Hopper, L.D.S. (Lpool.), 14,
Eshe Road, Blundellsands, Liverpool, 23;

Mr. S. W. Edworthy, L.D.S., R.C.S.
(Eng.), 1, Lower Lake, Battle, Sussex;

Mr. J. C. Ritchie, L.D.S., R.C.S. (Eng.),
14, South Street, Romford, Essex;

Mr. B. E. Fainsinger, B.D.S., 1013,
Salisbury House, West Street, Durban,
South Africa (Corresponding Member).

THE SEVENTH NORTHCROFT MEMORIAL LECTURE

The PRESIDENT, in introducing Professor D. Slome, who was to give the Seventh Northcroft Memorial Lecture, entitled “The Physiology of Muscle in Relation to Orthodontics,” said that Professor Slome was a Master of Arts, a Doctor of Philosophy, and a Bachelor of Medicine and Surgery, and he was Resident Lecturer in Applied Physiology at the Royal College of Surgeons.

Professor D. Slome read the following paper :

“The Physiology of Muscle in Relation to Orthodontics.”

The PRESIDENT, in proposing a vote of thanks to Professor Slome for his very interesting and masterly lecture, said that the Northcroft Memorial Lecture was an important feature of the Society’s programme each year, and the members looked forward to hearing a lecture on a subject which was somewhat different from those that they usually discussed. On the present occasion they had heard an excellent lecture on a very interesting subject, and he was sure that they now had a much better idea of muscle behaviour.

The vote of thanks was accorded with acclamation.

The PRESIDENT thanked Mr. Tulley for opening the discussion and Mr. Ballard for showing the slides, and the meeting then terminated.

Annual General Meeting

held on December 11th

THE ANNUAL GENERAL MEETING of the Society for the year 1953 was held at Manson House, 26, Portland Place, London, W.1, on Monday, December 14th, 1953, at 7 p.m. Mr. J. F. Pilbeam, President, occupied the Chair.

The Minutes of the Ordinary Meeting held on November 9th, 1953, were read, confirmed and signed.

ELECTION OF OFFICERS AND COUNCILLORS

The PRESIDENT said that the following list of Officers and Councillors nominated by the Council for the year 1954 had been circulated to the members:—

President: Mr. W. TREVOR JOHNSON.

Immediate Past President: Mr. J. F. PILBEAM.

Vice-Presidents: Dr. L. LINDSAY, Mr. H. CHAPMAN, Mr. K. E. PRINGLE, Mr. J. H. HOVELL.

Secretary: Mr. H. RICHARDS.

Treasurer: Mr. J. S. BERESFORD.

Librarian: Mr. A. G. TAYLOR.

Editor: Mr. C. F. BALLARD.

Curator: Mr. W. J. TULLEY.

Councillors: Mr. S. E. WALLIS, Mr. J. H. GARDINER, Mr. H. L. LEECH.

There having been no other nominations, The PRESIDENT moved that the above be elected.

The motion was carried unanimously.

ELECTION OF TWO AUDITORS

Mr. R. E. RIX moved the re-election of Mr. S. B. Newton and Mr. T. L. Winn as Auditors of the Society, and Miss L. CLINCH seconded the motion.

The HON. TREASURER (Mr. J. S. Beresford) reported as follows:—

HON. TREASURER'S REPORT FOR THE YEAR
ENDING 30th SEPTEMBER, 1953.

By comparison with last year the excess

of income over expenditure is greater by £35 2s. 0d. This year the income from members subscriptions and sale of Transactions has increased by £15 5s. 2d.

On the expenditure side our costs for printing and stationery continue to increase.

It is hoped that with the publication of the Transactions by Messrs. John Wright & Sons there will be a substantial reduction in cost. This is dependent upon a substantial proportion of the Society's members subscribing to the *Dental Practitioner*. The direct advantage would be the speedy receipt by members of the printed reports of the Society and the indirect advantage would be an improvement in the Society's financial position.

The work of keeping the Society's accounts could be appreciably reduced if as many members as possible would pay their subscriptions by means of a Bankers Order.

The motion was carried unanimously.

On the motion of the HON. TREASURER, seconded by Miss L. CLINCH, the report was received.

In reply to a question whether the subscription to the *Dental Practitioner* was the same as that to the *Dental Record*, Mr. C. F. BALLARD said that the subscription to the *Dental Practitioner* was £1 10s. 0d. per annum and that to the *Dental Record* was £1 0s. 0d. per annum.

On the motion of Mr. H. CHAPMAN, seconded by Mr. N. GRAY, the report was adopted.

The HON. SECRETARY (Mr. H. Richards) reported as follows:—

SECRETARY'S REPORT TO THE ANNUAL
GENERAL MEETING 1953.

In the 12 months from December 1952 to November 1953 seven meetings have

been held, with an average attendance of 97 members and visitors. More than 100 were present on four occasions, with a maximum of 143 at the May meeting. The attendances speak well for the standard of the Papers presented to the Society and the average could well have been over 100 per meeting, had not a dense fog restricted one meeting to 64.

During the year 29 new members have been admitted to the Society whilst there have been 5 resignations and five deaths.

The membership at the 1st January is expected to be 387, as compared with 368 in January 1953.

A letter has been received suggesting that one meeting in every year be held outside London, as this might result in an increase in the numbers of provincial members. The matter is being actively discussed by the Council, particularly as to the form the meeting should take, and the cost to the Society in view of the heavy charges for printing. A sub-committee has been appointed to enquire into the suggestion and a request has been made on the circulated agenda for this present meeting that members submit their views to me in writing before the end of the month. These views would be very helpful to the sub-committee and it is hoped that a good response will be forthcoming.

The Council of the Society are pleased to report that Mr. K. E. Pringle has been invited by the Minister of Health to serve on the Dental Advisory Committee. Mr. Pringle has accepted the invitation.

The Executive Committee of the Royal Society of Tropical Medicine and Hygiene has granted permission for our members to use the Fellows Room as well as the Committee Room for refreshments after our meetings.

Mr. President, I move the adoption of this report.

On the motion of the HON. SECRETARY, seconded by Mr. S. E. WALLIS, the report was received.

In reply to the question whether the

meetings "outside London" which had been suggested meant meetings in the provinces or near London, The HON. SECRETARY said that the suggestion which the Council had received was that one meeting per year should be held in Liverpool, Newcastle, Bristol, or Birmingham, as it was thought that this would stimulate membership in the provinces. He thought he ought to say that approximately 60 per cent of the British membership of the Society were within fifty or sixty miles of London. It was very difficult to form any estimate of the number of people who would attend a meeting of the Society in the provinces.

Mr. H. WATKIN supported the proposal.

Mr. C. F. BALLARD also supported it. He thought there were many people interested in orthodontics who were in the teaching hospitals outside London, and he did not think they would want to spend the time or the money to come to London merely to attend one meeting of the Society. He suggested that a two-day or three-day conference should be held outside London; he thought that that would be appreciated particularly by the younger members of the orthodontic branch of the profession and that many new members would be attracted to the Society in that way.

Miss L. CLINCH said she thought that the younger members would prefer to come to London for a conference. Those in Birmingham, for instance, would not want to go to Newcastle for a meeting or a conference. London was the centre to which most people wanted to come.

Mr. J. R. E. MILLS, speaking as a provincial member of the Society, said that the question was not entirely one of attracting new members in the provinces. The Society had a large number of members there, but most of them never came to the meetings of the Society in London. He thought they would like to attend meetings nearer home.

Mr. G. C. DICKSON suggested that the meetings of the Society in London should

be held a little earlier in the evening, so that provincial members could attend them without having to spend a night in London. The Royal Society of Medicine held its meetings at 5.30 and they were attended by a large number of provincial members.

The HON. SECRETARY said that within the last few years the time of the meetings had been changed from 8 p.m. to 7.30 p.m., but that had been done on a small vote, and the Council had decided to discuss this question with the question of the meetings in the provinces, as both suggestions were presumably made for the benefit of the provincial members.

The PRESIDENT drew attention to the notice on the Agenda asking members to send their views on the question of provincial meetings to the Hon. Secretary before the end of December.

Miss R. CASELEY, in supporting the suggestion that a conference should be held once a year outside London, asked whether it was intended that it should be held in addition to the usual number of meetings in London. She did not think that an isolated meeting outside London would induce orthodontists in the provinces to join the Society, but she thought that a conference might do so.

The HON. SECRETARY said that the suggestion which had been received was that one meeting of the Society (not a conference) should be held in the provinces, preferably the May meeting.

Mr. C. BULL suggested that if it was desirable for the provincial members to have meetings a series of local discussion groups or branches of the Society might be formed in the various cities and towns.

The PRESIDENT said the Council had set up a Sub-Committee to consider the question of meetings in the provinces and he was sure that it would take into consideration the suggestions which had been made at the present meeting. A report on the subject would be submitted to the members at the next Annual General Meeting.

On the motion of Mr. H. CHAPMAN, seconded by Mr. W. J. TULLEY, the report was adopted.

The HON. LIBRARIAN (Mr. A. G. Taylor) reported as follows:—

REPORT OF THE HON. LIBRARIAN, DECEMBER 1953

This has been a busier year—over thirty items have been borrowed from the library by members. This may not seem a large number but it is slowly increasing and the library is also responsible for answering questions and for the sale of Transactions; the latter appearing as an item in the Hon. Treasurer's statement.

In the past year the Society has purchased Sarnat's "The Temporomandibular Joint" and has received as gifts from P. Maxwell Stephens, Robert Cutler and the R.S.M. the following items: Twenty volumes of past Transactions, Mayoral's "Classification Y Nomenclatura De Las Anomalias Dentofaciales," Sillman's "Thumb Sucking and the Oral Structures" and Tnoge's "The Early Development of Teeth"; all these being reprints. The library receives the American Journal of Orthodontics and the Angle Orthodontist.

The first International Congress of Medical Librarians was held in London this year and I attended as the Society's delegate. There were interesting discussions on classifications, abstracting and the high cost of German publications while the social side was not neglected.

Finally I wish to ask all members who have any spare copies of the Transactions published since 1939 to give these to the library as most of these volumes are now out of print and there is a constant demand from University libraries.

On the motion of the HON. LIBRARIAN, seconded by Mr. H. WATKIN, the report was received.

There being no discussion on the report, the HON. LIBRARIAN moved its adoption, the motion being seconded by Miss L. CLINCH and carried.

The HON. EDITOR (Mr. C. F. Ballard) reported as follows:—

REPORT OF HONORARY EDITOR, 1953

I had hoped that I would not again have to begin an editorial report with the usual apology for delay in the publication of the Transactions. I can, however, assure you that both the 1951 and 1952 Transactions will be in your hands within the next two or three weeks.

You will have seen from the Agenda that the Council have decided to put the publication of our papers and the production of our Transactions in the hands of Messrs. John Wright & Sons of Bristol, who produce the Dental Practitioner. This is a very important and, I feel sure, a satisfactory change. John Wright & Sons are medical publishers, and the Dental Practitioner maintains a high standard. The Dental Practitioner will not, after March, be the recognised journal for the Technicians' Branch of the Surgical Instrument Manufacturers Association. It will, however, be the journal for the publication of the proceedings of the Society of Periodontology, and it is hoped also to publish articles from the Prosthetics Society, and articles on paedodontia. It seems to me that a journal that specialises in these four subjects will be an excellent publication, not only for the specialist, but for the general practitioner. John Wright & Sons have assured us that if the papers are produced for publication by the 20th of the months following the Society's meeting, they will be published in the next issue. This will require the co-operation, not only of the readers of the papers, but of all those who take part in the discussions, because it is proposed to publish with the papers a précis of the discussion. This, I feel, will make publication of papers much more valuable. As you know, we have not been able to publish discussions in the Dental Record.

This move to another publisher will save the Society at least £100 a year, but it

might also result in the saving of another £100 if at least 200 of our members subscribe to the Dental Practitioner.

We have been assured by John Wright & Sons that the Transactions can be produced within approximately two months of the publication of the last paper each year.

Our thanks are due to Mr. Trevor Johnson, who initially negotiated with John Wright & Sons.

Finally, I would like to take this opportunity of thanking members for their patience and lack of criticism of the Editor for the delay in the publication of the Transactions.

On the motion of the HON. EDITOR, seconded by Mr. A. G. TAYLOR, the report was received.

Mr. HARVEY asked whether it was necessary, when ordering the *Dental Practitioner*, to state that one was a member of the Society.

The HON. EDITOR said that he was not sure, but he did not think it would be necessary to do so.

The PRESIDENT said it was very encouraging to hear that two issues of the Transactions, those for 1951 and 1952, would be in the hands of the members within the next few weeks.

The HON. EDITOR said the Council had asked him to mention that the *Dental Record* would be publishing the papers and short communications read at the October, November and December meetings this year, and members who wished to have those should take the *Dental Record* for at least the next four months.

On the motion of the HON. EDITOR, seconded by Mr. S. G. MCCALLIN, the report was adopted.

The HON. CURATOR (Mr. W. J. Tulley) reported as follows:—

HON. CURATOR'S REPORT, DECEMBER 1953

Mr. President, Ladies and Gentlemen.

This year has been an uneventful one for the museum, but we have been fortunate

in obtaining some serial models from Mr. Jason Wood which have made a valuable contribution to our material. I would like to remind new members that the museum is housed next door in 28, Portland Place, adjoining the museum of the Institute of Public Health and Hygiene (9.30—5 p.m.). We are anxious to obtain further interesting material for the museum under one of these headings:—

- (a) Serial models of developing occlusions.
- (b) Models and possibly photographs and cephalometric tracings of treated cases.
- (c) Pathological conditions of the jaws and teeth which affect the occlusion.
- (d) Appliances of historical interest.

I beg to move the adoption of this report.

On the motion of the HON. CURATOR, seconded by Mr. R. E. RIX, the report was received.

There was no discussion on the report, and, on the motion of the HON. CURATOR, seconded by Mr. H. G. WATKIN, it was adopted.

ELECTION OF HONORARY MEMBER

The PRESIDENT, in moving that Mr. L. Russell Marsh of Hawthornden, Wharf Lane, Bourne End, Bucks, be elected an Honorary Member of the Society, said that Mr. Russell Marsh had regularly attended the meetings of the Society and had read several papers before it. He had been President of the Society a few years ago. All the members would be very sorry indeed that, owing to ill health, Mr. Russell Marsh had ceased to be an active member so far as attending the meetings of the Society was concerned. He was sure that they would wish to send to Mr. Russell Marsh their best wishes for the future.

The motion was carried with acclamation.

The PRESIDENT said he would ask the Hon. Secretary to convey the best wishes

of the members to Mr. Russell Marsh with the notice of his election to Honorary Membership of the Society.

Visitors were then admitted and were welcomed by the President, who expressed the hope that they would take part in the discussions.

Apologies for absence were announced from Dr. L. Lindsay, Dr. Russell Logan and Mr. Trevor Johnson.

ELECTION OF MEMBER

The following candidate for membership of the Society was duly elected by show of hands:—

Mr. A. J. H. Seymour, L.D.S., R.C.S. (Eng.), 20, Crouch Street, Colchester.

The following short communication was then read:—

“Orthodontic Traction with Removable Appliances,” by Mr. S. Granger McCallin.

The vote of thanks was accorded with acclamation.

The following paper was then read:—

“The Relation of Spacing of the Upper Central Incisors to Abnormal Fraenum Labii and Other Features of the Dento-Facial Complex,” by Mr. C. P. Adams.

The vote of thanks was accorded with acclamation.

Mr. LEIGHTON proposed a vote of thanks to Mr. Pilbeam, the retiring President, for all the valuable services that he had rendered to the Society during his term of office.

The motion was carried with acclamation.

The PRESIDENT expressed his gratitude to the members for their vote of thanks, which he appreciated very much indeed.

Owing to the absence of Mr. Trevor Johnson through illness, his induction as President would have to be postponed to the next meeting of the Society, on January 11th, when it would be his pleasant duty to induct Mr. Trevor Johnson to the office of President.

The meeting then terminated.

THE BRITISH SOCIETY FOR THE STUDY OF ORTHODONTICS

Balance Sheet and
Income and Expenditure Account

FOR THE YEAR ENDED 30th SEPTEMBER, 1953

FREDK. B. SMART & COMPANY, CHARTERED ACCOUNTANTS

22 Queen Street, London, E.C.4.

THE BRITISH SOCIETY FOR THE STUDY OF ORTHODONTICS

INCOME AND EXPENDITURE ACCOUNT for the year ended 30th September, 1953.

[illegible]

THE BRITISH SOCIETY FOR THE STUDY OF ORTHODONTICS

BALANCE SHEET as at 30th September, 1953.

1952				1952				
£	s.	d.	£	s.	d.	£	s.	d.
<i>Accumulated Fund:—</i>				<i>Furniture and Office Equipment:—</i>				
Balance at 1st October, 1952 ..				Balance at 1st October, 1952 ..				
Add Excess of Income over Expenditure for the year ..				Less: Depreciation at 5% per annum on Cost ..				
1,679	6	10	1,980	4	3	428	1	0
<i>Creditors:—</i>				<i>Debtors:—</i>				
Transactions—1951, 1952, 1953 ..				1953 Subscriptions received since 30th September, 1953 ..				
(Estimated by Hon. Treasurer)								
26	5	0	1,500	0	0			
22	10	0	26	5	0			
7	17	6	22	10	0			
11	0	0	7	17	6			
1	18	6	11	0	0			
2	2	0						
23	10	8	3	10	0			
8	8	0	6	2	6			
Reporting ..				£691 5s. 10d. 2½% Consolidated Stock at Cost ..				
Audit and Accountancy ..				(Approximate Market Value £895)				
				575 14 0				
				1,585 13 0				
				1,025 14 0				
				186				
<i>Cash at Bank:—</i>				<i>Cash in Hand:—</i>				
Westminster Bank Limited ..				Honorary Treasurer ..				
Post Office Savings Bank ..				Honorary Secretary ..				
1,007	7	4						
817	13	6						
				11 6				
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Certified in accordance with the Books and Vouchers of the Society.
We have verified the Investments and Cash at Bank.

S. B. NEWTON } *Hon. Auditors.*
T. L. WINN }
J. S. BERESFORD, *Hon. Treasurer.*

FREDK. B. SMART & Co.,
Chartered Accountants.

10th November, 1953.

London, E.C.4.

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